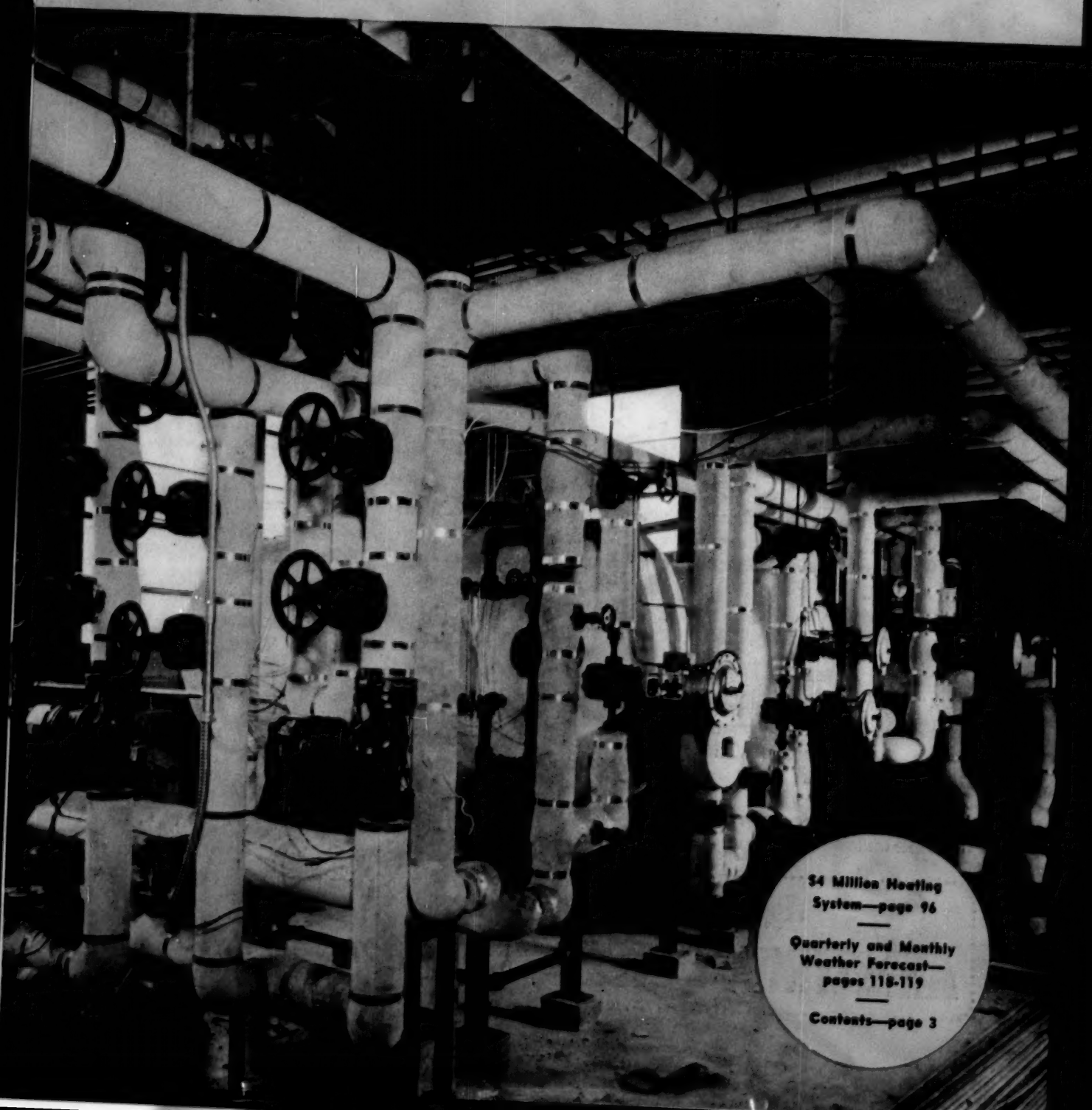
# AIR CONDITIONING HEATING AND VENTILATING

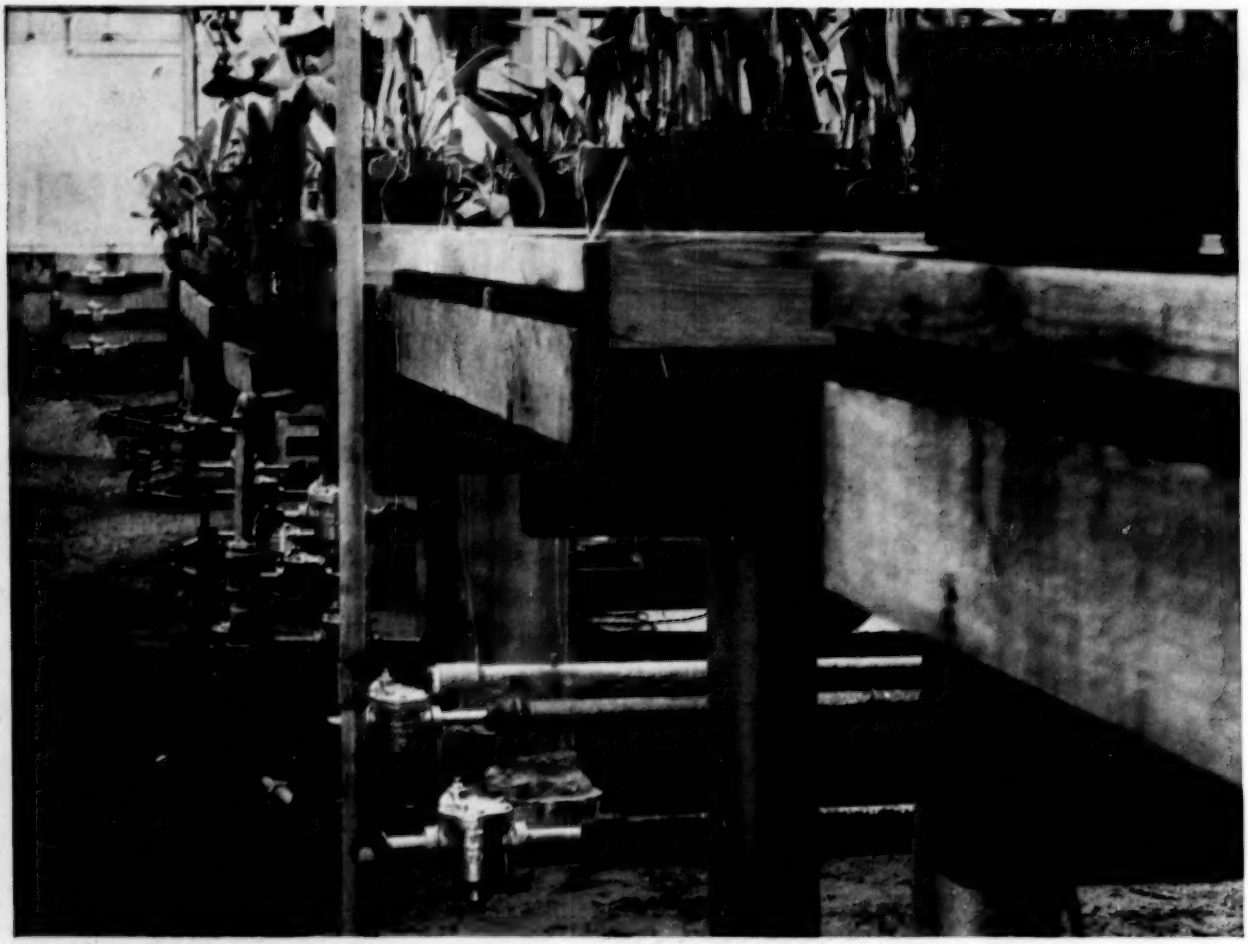
JUNE, 1955—52nd YEAR



$4 Million Heating System—page 96

Quarterly and Monthly Weather Forecast—pages 118-119

Contents—page 3



# "No trouble holding vacuum with these traps"

"They certainly are an easy trap to maintain. We haven't done a thing to them yet—and no more trouble holding vacuum", says Joseph Vermuelen, Floral Avenue Greenhouses, Mt. Clemens, Mich.

Dozens of Armstrong "blast" traps are used at this greenhouse to drain heating coils operating at 2 to 10 lbs. pressure with a 10" vacuum return.

Armstrong traps are especially desirable for low pressure vacuum return systems because of their durability and long service without leakage. (It's the leaky traps that make you lose vacuum.)

There is nothing in an Armstrong trap to rupture. The bucket is open. Every trap is factory tested at 500 lbs. water pressure. Hardened chrome steel valve and seat ... stainless steel bucket and lever assembly—the same design, materials and workmanship used in Armstrong traps for power plant service at 900 lbs. pressure, 900 degrees temperature! It's no wonder they last for years without repairs in low pressure vacuum return service. Don't ever let anyone tell you the Armstrong inverted bucket trap isn't good for this service. It's best! There's proof galore. Ask your Armstrong Representative for the facts, or write:

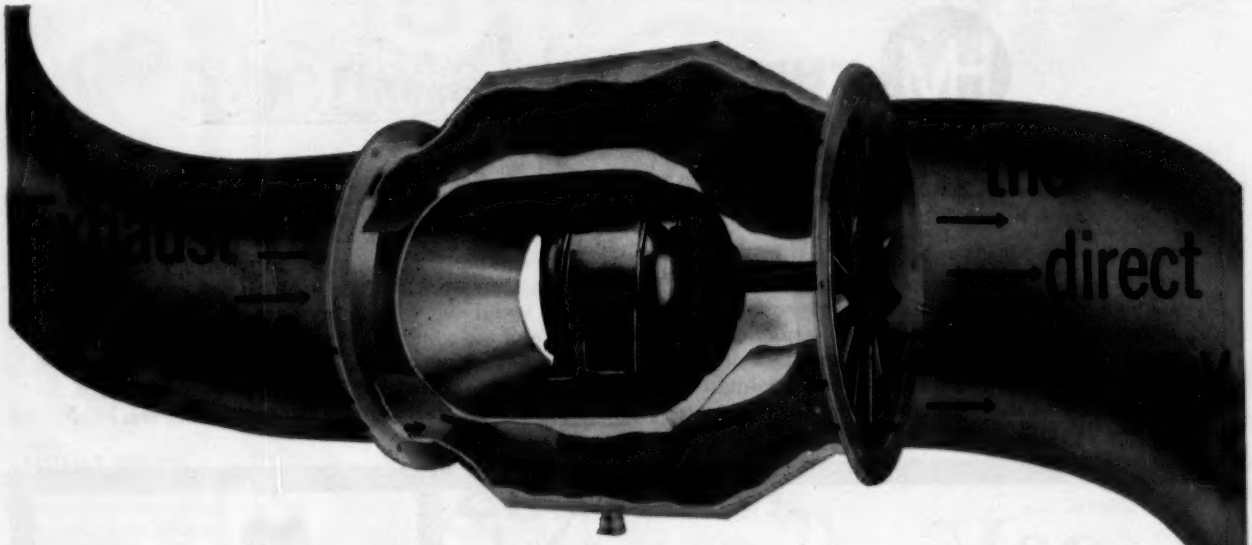
**ARMSTRONG MACHINE WORKS**
846 Maple Street, Three Rivers, Michigan

*Application Engineered*

# ARMSTRONG STEAM TRAPS

**FREE FACTS FOR YOU ...**
Ask for these reprints: "Vacuum isn't Vacuum to a Steam Trap" and "Flash at Traps". Here are facts to give you better trapping. Write or call today, no obligation.

535




# BIFURCATOR FAN EFFICIENTLY EXHAUSTS HOT, CORROSIVE, FLAMMABLE AND EXPLOSIVE FUMES

Bifurcator Fans exhaust fumes at *top efficiency* by avoiding a directional change in the air stream. Other fans often require a 90° change in direction of the exhaust stream with resultant loss in efficiency.

The fan motor stays clean, cool and accessible. Fumes are by-passed (bifurcated) around the motor chamber which is completely isolated from the exhaust stream.

Bifurcator Fan installs just like a section of ductwork.

A Bifurcator Fan is easily installed . . . just like a flanged section of ductwork. It can be mounted horizontally, vertically or at an angle. Lightweight and extremely compact, a Bifurcator requires no platform or supports. Bifurcators are available in sizes from 1140 CFM (12" diameter fan with 1/20 HP motor) up to 45,000 CFM (48" diameter fan with 20 HP motor). Housings and fan wheels can be fabricated of non-corrosive metals, or can be protected with a variety of corrosion-resistant coatings.

Be ready with the facts about Bifurcators next time you have a fume removal problem. Fill in and mail the handy coupon below . . . TODAY!

Certified Ratings

AMCA

## DeBothezat Fans

**DEBOTHEZAT FANS DIVISION**
**Dept. HV-655**
**American Machine and Metals, Inc.**
**East Moline, Illinois**

**FREE!**

Please send me "Design Data for Exhaust Systems" and Bifurcator Bulletin DB-4-52.

FIRM NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

NAME AND TITLE _____

# THE ONLY Matched

## COOLING TOWERS and CONDENSERS

The Halstead & Mitchell Cooling Towers you select are *matched* by design to work with the famous Halstead & Mitchell water-cooled Condensers. You need no longer buy a high-efficiency cooling tower to work with a low-efficiency condenser (or *vice-versa*) . . . a long-life cooling tower to work with a short-life condenser (or *vice-versa*).

Remember that every cooling tower you sell is planned to work with a water-cooled condenser—then you'll see why America's leading manufacturers of air-conditioning and refrigeration equipment have swung to Halstead & Mitchell for their original equipment needs in both these components.

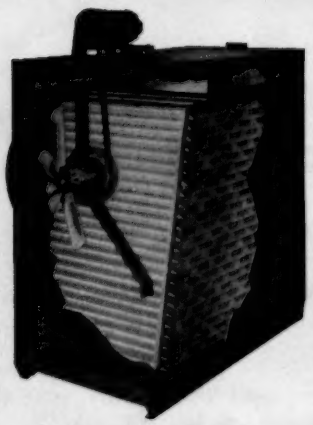
With cleanability you'll sell more. Why sell less?

## 20-Year Guarantee!

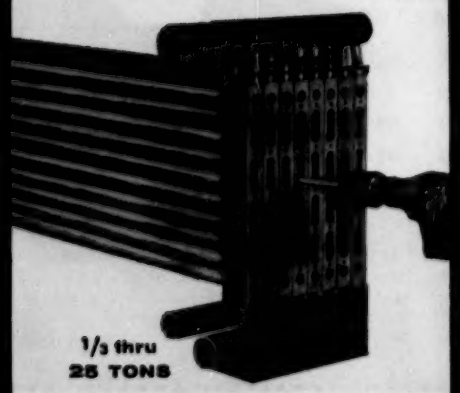
**on the wetted deck surface against rotting or fungus attack**

Only Halstead & Mitchell pressure-creosoting can provide a *guarantee* against immediate attack by fungus and marine parasites . . . or chemical deterioration from acids in water.

Added to this H&M exclusive are other major advantages. There's ultra-high efficiency in the gravity-type water distributing pan which eliminates extra pumping head required on spray type towers . . . and cuts down on water losses due to "atomizing" of water. And there's extra-long life in stainless steel fans . . . and sheet steel cabinets hydraulically painted with vinsynite, vinyl zinc and chlorinated rubber.



**2 thru 120 TONS**



**1/3 thru 25 TONS**

## Lifetime Cleanability

The *mechanical* cleaning of H&M double-tube, counter-flow condensers means the simplest, least dangerous method of restoring new unit efficiency. Whether removing a heavy coating of sludge and scale, or a thin insulating film on the inner walls of the copper tubing, the mechanical cleaning tool restores heat transfer efficiency in a matter of minutes. The result is lowered discharge pressures . . . more heat carried off by cooling water . . . lower bills. *Only* the impurities are removed . . . the thickness of the copper wall remains intact, and the condenser gives extra years of peak service.

**At Leading Heating and Refrigeration Wholesalers EVERYWHERE**

*Write for Detailed Specifications*

Halstead & Mitchell

BESSEMER BUILDING • PITTSBURGH 22, PA.

# AIR CONDITIONING HEATING AND VENTILATING

JUNE, 1955

**Editorial Staff**
Editor
CLIFFORD STROCK
Associate Editors
NATHAN N. WOLPERT
WILLIAM B. FOXHALL
Assistant Editor
WALLACE G. HOLBROOK

**Published by**
THE INDUSTRIAL PRESS

Executive, Editorial and Subscription Offices,
93 Worth St.,
New York 13, N. Y.

## CONTENTS

VOL. 52 No. 6

### FEATURE ARTICLES

Part-Load Operation of Centrifugal Compressors—A. M. G. Moody ..... 85
Liquid Heating and Cooling for Year-Round Air Conditioning—W. B. Cooper ..... 89
Air Conditioning Improves Health of Animals ..... 95
High Temperature Water ..... 96
Costs Cut by Mechanical Draft—W. J. Matiez ..... 115
Electronic Brain Speeds Building Studies ..... 117
Centrifugal Pump Materials—I. J. Karassik, R. Carter ..... 120
Plastic Piping For Acids ..... 123
Thermostat Made for Blind Couple ..... 148

### REFERENCE MATERIAL

Section—Energy Equations for Flow and Nonflow Systems—F. W. Hutchinson ..... 97
Detail Sheet—Indirect Water Heaters ..... 113
Data Sheet—Tables for Determining Relative Humidity ..... Opposite 176

### DEPARTMENTS

High Spots ..... 5
Washington Overtones—L. Overman ..... 6
Briefly Stated ..... 10
Piping and Plumbing—L. Blendermann ..... 111
Temperature Forecast ..... 118
News of Equipment and Materials ..... 124
New Catalogs ..... 139
London Letter ..... 142
What Would You Do? ..... 146
Degree Days for April, 1955 ..... 150
News of the Month ..... 154
Ad-Digest ..... 157
Canadian Degree Days for April, 1955 ..... 162
Coming Events ..... 164
Index to Advertisers ..... 175

**The Cover:** One of 75 heat transfer stations in $4 million high temperature hot water system installed at McGuire Air Force Base in New Jersey by Charles Simkin & Sons, Inc., to designs by American Hydrotherm. Other pictures on page 96.

**AIR CONDITIONING, HEATING AND VENTILATING,** published monthly by The Industrial Press, 116 Main St., Norwalk, Conn. Executive, editorial and subscription offices, 93 Worth St., New York 13, N. Y. Entered as second-class matter, February 16, 1954, at the Post Office, Norwalk, Conn., under Act of March 3, 1879.

**Subscription Rates:** In the United States and Canada, one year, $3; two years, $5; three years, $6; in all other countries, one year, $7; two years, $11. Single copies, 30 cents.

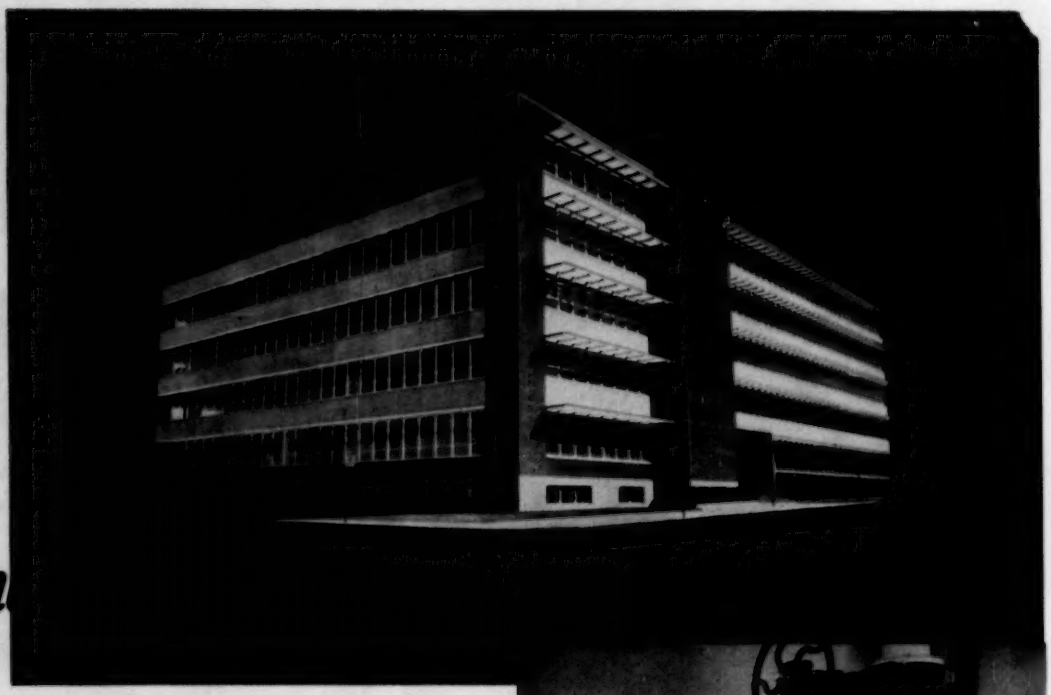
**Copyright:** Copyright, 1955, by The Industrial Press, New York, N. Y. Permission required to reproduce articles.

**Member** of National Business Publications, Business Publications Audit, Society of Business Magazine Editors.

**Executive Officers, The Industrial Press:** President, Robert B. Luchars; Vice-President and Treasurer, Edgar A. Becker; Secretary and Publishing Manager, Harold L. Gray.

**Advertising Representatives:** George G. Turner, 228 N. La Salle St., Chicago 1, Ill.; Harry J. Twine, 93 Worth St., New York 13, N. Y.; Thomas A. Earing, 93 Worth St., New York 13, N. Y.; Edward B. McEntee, 17115 Hillsboro Rd., Cleveland 12, Ohio; Robert H. Deibler, 2506 W. 8th St., Los Angeles 57, Calif.

**Indexing and Microfilm:** Contents of AIR CONDITIONING, HEATING AND VENTILATING are indexed monthly by Industrial Arts Index and microfilmed by University Microfilms, Ann Arbor, Mich.



*The Stearns-Roger Building, home office of the firm at Denver, Colorado, designed, engineered, and constructed by Stearns-Roger with Mr. J. Roger Musick as consulting architect.*

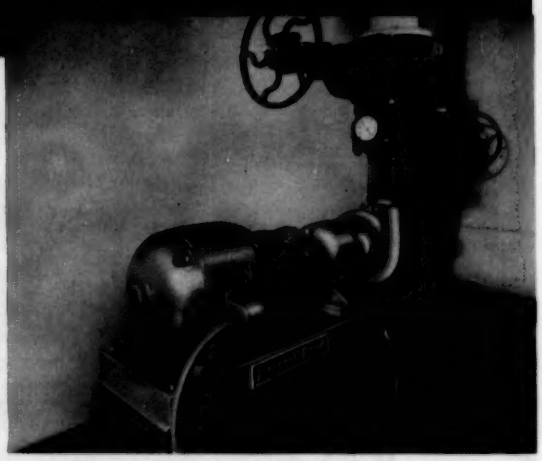
# Air Con

## *and Ingersoll-Rand Centrifugal Pumps play their part . . .*

Installations such as this are becoming the rule rather than the exception these days. Even in the cooler areas of the country, office buildings, theatres, shopping centers, restaurants, hotels, hospitals, etc. are catering to the comfort of their employees and customers with central system air conditioning.

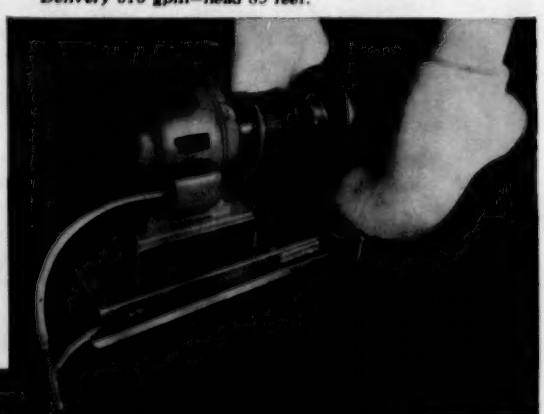
Ingersoll-Rand Centrifugal Pumps from ¼ horsepower up are ideal for cooling tower or chilled water service anywhere. These dependable pumps help give indoor comfort day in and day out with minimum maintenance and maximum efficiency.

When you are working on an air conditioning job check Ingersoll-Rand Circulating Pumps to do a bonus job for you. In the meantime, write for full information on I-R pumps for air conditioning service. Remember, the job is never too small nor too large for the Ingersoll-Rand Line.



*An Ingersoll-Rand Class 4CRVL 20 horsepower cradle-mounted pump on cold water circulation service. Delivery 860 gpm—head 55 feet.*

*An Ingersoll-Rand Class 4DMV 20 horsepower horizontally-split pump on cold water circulation service. Delivery 610 gpm—head 85 feet.*



**Ingersoll-Rand**

9-165 **11 Broadway, New York 4, N. Y.**

# HIGH SPOTS

**Largest woolen mill,** to be built by Textron in the South, will have 1000 workers, be completely air conditioned. Designers, Lockwood Greene Engineers, Inc., New York.

**Automatic anthracite-burning equipment** shipments for first quarter up 29% over 1954. March shipments 50% ahead of last year.

1,500,000 tons of **sulphur dioxide** are poured into New York City's air each year, the City Air Pollution Control Department states, resulting in high corrosion rates.

**Natural gas consumers** enjoy a luxury fuel, thus are not entitled to Government control of its price, Senator J. William Fulbright told a Senate committee.

**A fire control device** vents hot gases and smoke from localized fires on the principle of a fireplace, thus making spread of fire through other parts of a building easier to control. Made by Wasco Products, Inc., Cambridge, Mass., the device was tested in May at Factory Mutual laboratories.

**Europeans resist oil uses** as coal remains dominant political and economic force. In France, the use of oil for home heating actually is restricted by an agreement between the oil companies and the coal distributors' cartel. See News of the Month department in this issue.

**Mechanical Contractors Association of America** was selected, on the last day of their Houston convention, as the new name of the 66-year-old Heating, Piping and Air Conditioning Contractors National Association.

**The Atomic Energy Commission** is inviting proposals to purchase the heat produced in a reactor now under construction 30 miles northwest of downtown Los Angeles. Details in News pages.

**An increase of 43.6%**—largest in the industry's history—in sales of cast iron boilers for home heating was achieved in the first quarter of 1955 as compared to the first quarter of 1954, according to IBR.

**Industrial building contracts** are setting new highs for peacetime. Awards hit $974 million for this year by mid-May, topping the same period last year by 31%. Mass housing awards the first 20 weeks in 1955 were a sharp 62% ahead of the same period in 1954, while commercial building, up 33%, was also at a record high, according to Engineering News Record and Construction Daily.

**A new aluminum alloy** announced by Alcoa has greatly improved mechanical properties at temperatures in the range 500 to 600 deg F.

**Shipments of fans,** blowers, unit heaters and accessory equipment during 1954 totaled $257 million, up 3% over 1953, according to the Bureau of the Census, Department of Commerce. Of the 1954 total, fans and blowers accounted for $198 million, unit heaters $58 million, and air washers $1.4 million.

Atlantic City, N. J., Electric Co. predicts that **electricity will compete** with oil, gas, and coal for house heating within three years, with heat pumps installed in one out of 10 houses by 1965.

**By the end of 1965,** more than 10 million U. S. dwellings will be equipped with air conditioning, according to Mason Roberts, General Motors vice president and head of Frigidaire.

# WASHINGTON OVERTONES

by LORING OVERMAN

**Business,** in a rising crescendo approaching boom volume, sounds the keynote for Washington's current overtones. The Department of Commerce Office of Business Economics pulled out all the stops on May 16 when it released its report on **gross national product** for the first quarter of 1955.

GNP advanced to a $370 billion annual rate, as compared with $362 billion in the fourth quarter of 1954, and $356 billion in each of the preceding quarters of last year. The recent increase restored the dollar total of gross national product to its previous peak reached in the second quarter of 1953.

**Business forecasters,** private and public, are estimating that gains during later quarters may boost the GNP total for all of 1955 to $385 billion . . . possibly more.

Resulting overtones are no less distinct. Among them:

**Business regulation** efforts thrive when business is on the move . . . whether up or down. In this instance a divided Washington—with Democrat-controlled Congress and GOP White House—applies opposing pressures.

- **Senator Paul Douglas** (D-Ill.) advocated restrictions on the size of corporations. In testimony before the House Antimonopoly Subcommittee he said: "It is essential that not only should new mergers and concentrations of economic power be prohibited but that existing concentrations should be dealt with effectively and reduced under the antitrust laws."

- **Senator John Sparkman** (D-Ala.), in a public address, warned that the current wave of mergers threatens the existence of four million small business enterprises and is "a sure road to totalitarianism."

- **Senator Wayne Morse** (D-Ore.), also before the House Antimonopoly Subcommittee, urged that inquiry into antitrust aspects in the power utility field be further explored.

Meanwhile . . .

**Labor reportedly sees** in the current business activity an opportunity to press for further gains, aided and abetted by legislators of like mind.

- **Secretary of Labor Mitchell** has puzzled some GOP cohorts by urging passage of S. 1091—granting aid to states for industrial safety programs—same to be up to federal standards. Puzzle is that the recommendations go further and seek more power than proposals of previous administrations presumed to be more labor-minded.

- Also, business observers are viewing with concern **two new labor developments.** First is the AFL-CIO merger; second, outcropping of new buildings constructed by labor organizations as headquarters offices in Washington. AFL main office is across a park from the White House; others on Washington's Fifteenth, Sixteenth and Seventeenth streets—within sight of Presidential mansion.

- **Moves to compromise minimum wage legislation** at $1 per hour continue; extension of coverage under Wage-Hour Act is still a possibility.

- **Differences of opinion on Taft-Hartley** are so deep-seated that no action is anticipated at this session.

**Building Outlook** continues favorable, with growing indications that brakes will be applied cautiously to housing construction inducements.

(*Continued on page* 8)

# A FIRE Started in this School....

## Its Path was Barred by Multiple Accordion Aluminum!

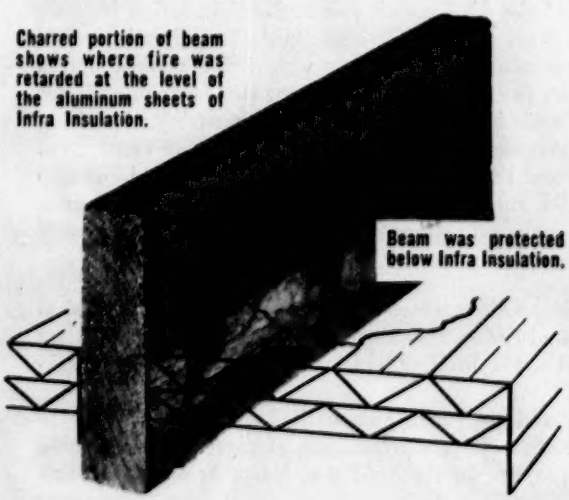
This is the New Bridge Elementary School in New Milford, N. J. When it was built, Arthur Rigolo, the architect, had specified Infra multiple accordion aluminum insulation, Type 6, and it was installed in the ceilings.

In July 1953, the roof of this school was set on fire from the outside. Most of the roof area ABOVE four classrooms was destroyed, but Infra Insulation protected their ceilings. The fire did not penetrate below the insulation.

The *ceiling beams* were found to have been charred by the fire ABOVE the insulation; but the SAME *ceiling beams* were NOT charred below it.

When the roof area was renovated in August 1953, Infra multiple accordion aluminum insulation was *again* installed between the roof beams.

Fires sometimes spread more rapidly when aggravated by Heat-Rays or Radiation; or because of flow of super-heated air. The surfaces of multiple accordion aluminum have a Heat Ray or Radiation absorptivity and emissivity of only 3%, with 97% reflectivity, whether the heat rays originate in the sun, a furnace, a warmed surface or a burning area in a building. Aluminum will not burn. It has a melting point of 1220° F. Even the fiber separators of standard Infra are flame-resistant.


Charred portion of beam shows where fire was retarded at the level of the aluminum sheets of Infra Insulation.
Beam was protected below Infra Insulation.

Photograph of section of ceiling beam removed from New Bridge School when fire damage was repaired.

To obtain maximum, uniform-depth protection against heat loss and condensation formation, it is necessary to use the new edge-to-edge multiple aluminum,* each sheet of which stretches from joist to joist, and also all through the flanges for further vapor protection as well as permanent attachment of each sheet of aluminum.

In addition to reflecting heat by Radiation, which represents 50% to 93% of all heat transferred through building spaces depending on direction of heat-flow, the layers of aluminum and fiber retard convection, or movement of warm air. The alternating air spaces have low density, therefore Conduction through them is slight. The solid aluminum sheets, long and continuous, are almost completely impervious to water vapor. Infiltration under the flat, stapled flanges is slight.

Condensation on or within this type of insulation is minimized by the scientific construction of multiple layers of aluminum, fiber and air spaces.

A very useful and interesting "Radiation Table" listing the Emissivity, Absorptivity and Reflectivity of the Surfaces of a long list of materials has been prepared by Alexander Schwartz, president of Infra Insulation, Inc. It is yours for the asking.

Also yours for the asking is an illuminating discussion of why and how aluminum insulates, even under extreme conditions. It will be found in the booklet "Thermal Test Coefficients of Aluminum Insulation for Buildings," published by the American Society of Heating & Air-Conditioning Engineers. A free copy, and samples of the new insulation sent by us on request.

*Patent applied for

**COST OF EDGE-TO-EDGE INFRA**
**Multiple Aluminum Insulation installed in new construction between wood joists, material and labor**

**Type 6-PS about 10¢ sq. ft. Type 4-PS about 8¢ sq. ft.**

Infra Insulation, Inc., 525 Broadway, N. Y., N. Y., Dept. V-6
☐ Please send FREE A.S.H.A.C.E. Booklet, "Thermal Test Coefficients of Aluminum Insulation for Buildings."

Name_____

Firm_____

Address_____

## WASHINGTON OVERTONES (*Continued from page 6*)

• **Commerce Department** announced on May 13 a survey of vacancies in all rental properties having 100 or more units. Purpose: to provide information on the supply of available apartments in relation to demand. Results of the survey are expected to have a bearing on future government policies re: rental housing.

• **New approach to the school construction** problem is provided in proposals of Representatives Kearns (R-Pa.) and Baily (D-W. Va.). Proponents suggest grants to states, no loans—U. S. to pay half of billion-a-year cost, splitting with states. Plan would cost more than Administration proposal, but might hurry completion of most-needed 300,000 classrooms during next six years.

• **Industrial expansion,** planned over 10-year program, is beginning to show prospects of taking up any slack in housing.

• **A five-year extension** of the Federal Housing Administration's Title I home repair and improvement program is being urged by several units of the building and home finance industry. Expansion of provisions for housing on college campuses is also being urged at hearings before the Senate Banking Subcommittee.

**Defense Production,** always of interest directly or indirectly to air-conditioning people, continues uninterrupted.

• House and Senate have both passed a **major appropriations bill** providing $31.5 billion for the Defense Department. Added to carry-over funds, the Department will have $43 billion to spend in the fiscal year beginning July 1.

• Efforts to get the Defense Department **out of competition** with private business revealed some differences of opinion. In passing the budget measure, the House took two votes on the question of permitting the Department to contract with private business for such items as rope and paint—things "traditionally produced" by civilian Defense Department employees. On a final roll call the House voted 202 to 184 to encourage private bidding.

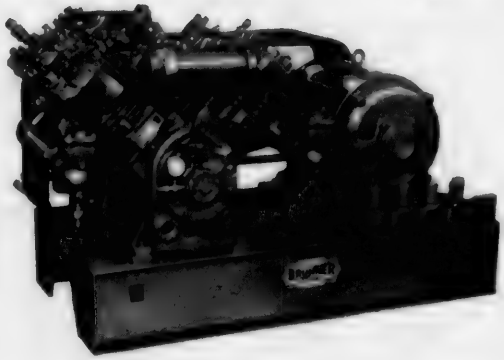
• **A bill to eliminate so-called bid-shopping** on federal construction projects is having tough sledding. Three government agencies—Defense, General Services Administration and Atomic Energy Commission—claimed the bill would encumber them with unnecessary details. The bill is strongly supported by mechanical specialty contractors engaged in electrical, plumbing, heating, and air-conditioning work. Plumbers' and electrical workers' unions of the AFL also support the bill.

**Washington Headquarters** of the Air-Conditioning and Refrigeration Institute was preparing to release, late in May, a new set of standards for advertising and selling room air conditioning equipment. The standards were being worked out in conjunction with the National Better Business Bureau. The new standards provide for a 16-point program designed to provide buyers with a basis for comparing advertising and sales claims. In general, the standards will explain that the cooling capacity of units to be compared should be tested under identical conditions. The standards also publicize the long established ASRE rule that no unit produced by a manufacturer should vary more than 8% from published ratings.

**Atomic Energy** continues to be an all-engrossing subject in Washington technical circles. Recent event of interest was a briefing May 19-20 at the Idaho National Reactor Testing Station at Idaho Falls, Idaho. The briefing was for firms interested in submitting bids on a test reactor.

AEC had announced earlier that it will take bids until July 1 on proposals to finance, construct and operate a test reactor for irradiation of cores, fuel assemblies and other components for reactor projects for the Air Force, Navy, Army and civilian nuclear power programs.

# Brunner planned it that way...



**BRUNNER CONDENSING UNITS**

. . . for remote air conditioning installation in commercial and industrial applications, are supplied in sizes up to 75 H.P. with capacity control. Brunner Compressor Units for use with evaporative condensers also available up to 75 H.P.

**BRUNNER AIR CONDITIONERS**

. . . completely self-contained, are available in various models up to 20 H.P. for residential or business installations. Easy to install, cost less to operate.

By choosing BRUNNER for dependable performance, thousands of users of Brunner Air Conditioners and Refrigeration Condensing Units have put their OK on Brunner quality.

This is not just a lucky coincidence . . . we planned it that way! Right at the beginning, we made up our minds that we were interested in producing only the best . . . and we've held to this objective for half a century.

Brunner "OK quality" is built into the product, step by step, from start to finish . . . pays off in finer performance, more years of trouble-free service, and lower operating costs. "SELL BRUNNER" with complete confidence that you are serving the best interests both of your customers and yourself.

Brunner offers a complete line of Refrigeration and Air Conditioning Condensing Units and Packaged Air Conditioners. See your Brunner representative, or write to:

**BRUNNER MANUFACTURING COMPANY, Dept. K-655, UTICA, N.Y.**
The Brunner Co., Gainesville, Ga.
*In Canada:* Brunner Corp. (Canada) Limited, Toronto, Ontario

BRUNNER
SINCE 1906

**BRUNNER EXTRAS**

- Compressor Experience
- Product Research
- Design Engineering
- Wide Product Range
- Proven Quality
- Complete Dependability
- Easy Servicing
- Warranted Performance
- Nearby Distributor Service
- Profit Opportunity
- Advertising Support
- Sales Promotion Help

# BRIEFLY STATED

• American Blower Corp. has announced the appointment of Robert L. Stickley as assistant advertising manager. Mr. Stickley, who recently returned to civilian life after serving two years as a Captain in the United States Army Ordnance Corps, formerly worked for Nelson Associates, a sales promotion firm; Progressive Welder Company; Brooke, Smith, French & Dorrance, advertising agency, and the Carboloy Corp.

• L. S. Wilcoxson who has been vice president in charge of research of The Babcock & Wilcox Company since 1945 has been appointed vice president in charge of the Boiler Division of the company. In his new position Mr. Wilcoxson will relinquish his research responsibilities to take charge of all activities in the Boiler Division which has six manufacturing plants throughout the nation. Mr. Wilcoxson joined Babcock & Wilcox in 1926. He was made an executive assistant in the engineering department in 1931 and vice president in charge of research in 1945.

• Chester S. Stackpole, general sales manager, Heating and Cooling Division, Union Asbestos & Rubber Company, Chicago, has been appointed managing director of the American Gas Association. He joined the Association June 1, succeeding H. Carl Wolf, who resigned earlier this year because of illness. Before becoming associated with Union Asebstos, Mr. Stackpole served as vice-president of the Williams Division of the Eureka Williams Corp. For three years previous to joining Eureka Williams in November, 1951, he served as vice-president and general sales manager, Airtemp Division, Chrysler Corp. For more than twenty years, Mr. Stackpole served as assistant manager, and then manager of merchandising, sales promotion, and domestic gas and electricity sales of Consolidated Gas Electric Light and Power Company of Baltimore, now the Baltimore Gas and Electric Company.

• Peter J. Dalton has joined Worthington Corp. as product manager of the Air Conditioning and Refrigeration Divisions Packaged Products Section. Mr. Dalton will be headquartered at Harrison, N. J. He previously served as vice president and general sales manager of the Davison Distributing Co., Detroit, Mich.

• In connection with the establishment of national headquarters of the Bryant Division of Carrier Corp. in Indianapolis, the firm has acquired an industrial site for administration, sales, engineering and research offices across from the Bryant manufacturing plant at 1100 West 21st Street, Indianapolis. The acquisition follows closely the announcement that Bryant is moving its home offices from Cleveland, Ohio.

• At the recent annual meeting of Albert Kahn Associated Architects and Engineers, Inc., two additional directors, R. E. Linton and S. King, were elected to bring the board membership to seven. Incumbent directors re-elected include: Geo. H. Miehls, G. K. Scrymgeour, S. Marston, S. Saulson and O. L. Canfield. Executive officers of the firm were re-elected as follows: Geo. H. Miehls, president and treasurer; S. Marston, executive vice president, and G. K. Scrymgeour, secretary. In addition, S. Saulson, O. L. Canfield, F. K. Boomhower, R. E. Linton, F. A. Fairbrother and S. King were elected vice presidents.

• Francis O. Case, president of the Glen Alden Coal Co. announced at the annual meeting of stockholders held in Wilkes-Barre in April that the company had purchased the Mathes Company of Fort Worth, Texas. This company manufactures heat pumps, house air conditioners, room coolers, large components for store, restaurant and similar air conditioning installations, fans and desert coolers. At the meeting the stockholders approved changing the name of the company from the Glen Alden Coal Company to Glen Alden Corporation.

• National sales of Springfield water-tube package generators will be made through the coast-to-coast network of Kewanee-Ross Boiler Division sales offices. The new sales set-up was revealed in a joint statement by W. B. Russell, president of Kewanee-Ross Corporation, Kewanee, Illinois, and George R. Atherton, president of the Springfield Boiler Company, Springfield, Illinois. Kewanee-Ross Corporation, a division of the American Radiator & Standard Sanitary Corporation, maintains sales engineering offices in fifty-three cities with plants located in Kewanee, Illinois; Lebanon, Pennsylvania and Buffalo, New York. The new name for the products will be the Kewanee-Springfield water-tube package generator. The sales arrangement does not affect or include Springfield's custom design and other types of field erected boilers. Springfield Boiler Co. will do all manufacturing of the Kewanee-Springfield package unit.

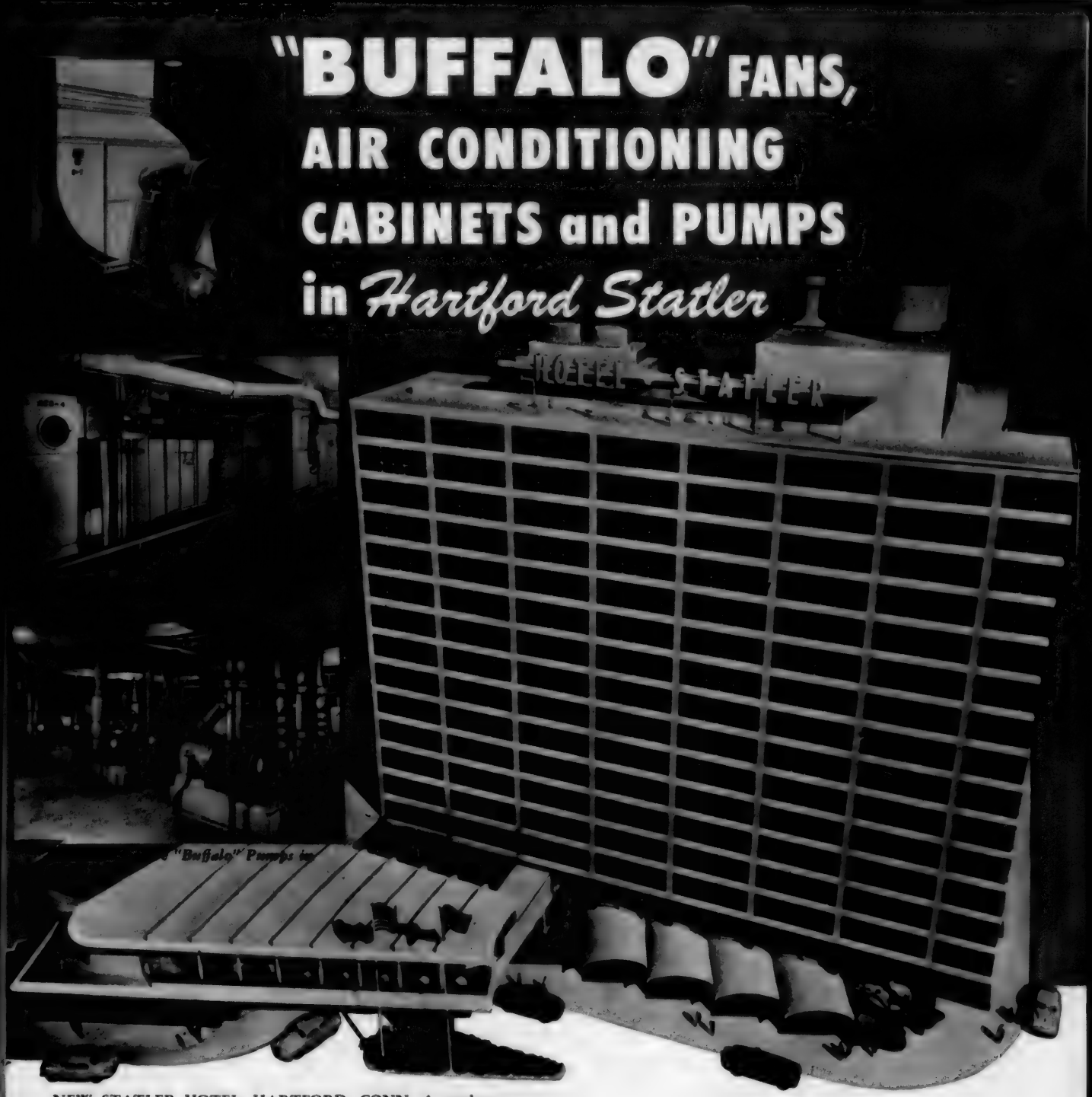
• Plans for the construction of a new factory building in Chicago at an estimated cost of $1,750,000 have been announced by Minneapolis-Honeywell Regulator Company. The new factory, of steel and brick construction, will provide 150,000 sq ft of floor space for offices and for expanded engineering and manufacturing activities, with completion of the building expected by November.

• Engineers Joint Council has announced at its headquarters in New York the election of The American Society of Refrigerating Engineers as a constituent society. It also announced the election of the American Institute of Industrial Engineers as an associate, the first organization to become an EJC associate. EJC now has nine constituent societies with a total membership of more than 196,000.

• Ladish Co, Cudahy, Wis, manufacturer of forged and seamless welding fittings, has recently announced the appointment of Fred K. Krell as assistant sales manager, Fittings Division

• Warren Webster & Co., Camden, New Jersey, have announced the sale of Warren Webster & Company, Ltd, of London, England, to Lomax and Smith, Dundee, Scotland. Production of Webster traps is now under way at the East Kingsway Works of Lomax and Smith.

# "BUFFALO" FANS, AIR CONDITIONING CABINETS and PUMPS in *Hartford Statler*




NEW STATLER HOTEL, HARTFORD, CONN. A modern 450 room addition to the Statler chain. Architect, William B. Tabler; Engineers, Jaros, Baum & Bolles; Heating & Ventilating Contractors, Alvord & Swift.

● Great confidence is placed in all "Buffalo" equipment by leading businessmen. An outstanding example of this is the newest of the fine Statler Hotels. Here, "Buffalo" fans supply needed ventilation to all public rooms and service areas. "Buffalo" air conditioning cabinets provide ideally conditioned air for these areas. "Buffalo" pumps move large quantities of chilled and hot water to the air conditioning system and power plant. Years of satisfaction, money-saving operation and patron-comfort are insured where "Buffalo" "Q" Factor equipment is installed.

The next time you are considering a ventilation or air conditioning investment remember the 78 years experience available to you in all "Buffalo" equipment.

**The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.*

## BUFFALO FORGE COMPANY

480 BROADWAY BUFFALO, N. Y.

*PUBLISHERS OF "FAN ENGINEERING" HANDBOOK*

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

*Sales Representatives in all Principal Cities*

"Buffalo"

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

Here today.....

# AND HERE TOMORROW, TOO!

*the permanent installation is*

## DURIRON ACID RESISTING DRAIN PIPE

Duriron is a high silicon iron alloy with a very high resistance to corrosion, abrasion and erosion. This resistance is present throughout the entire pipe wall.

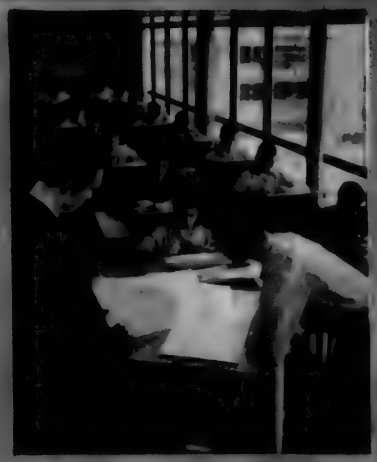
Installed by ordinary plumbing methods, Duriron can be counted on to outlast the building, in most cases. Obviously, replacement and building repairs are virtually eliminated. Bulletin PF/4 lists complete details and standard fittings. Insist on *Duriron*.

**A PARTIAL LIST OF RECENT DURIRON INSTALLATIONS**

Roswell Park Memorial Institute, Buffalo, N. Y.
University of Texas Medical Center, Galveston, Tex.
Derrance Laboratory, M.I.T., Cambridge, Mass.
Tippecanoe Laboratories,
Eli Lilly and Company, Lafayette, Ind.

**THE DURIRON COMPANY, INC.**
**DAYTON, OHIO**

DURIRON
LOOK FOR THIS NAME ON EVERY PIECE



# ST. PATRICK HIGH SCHOOL, CHICAGO

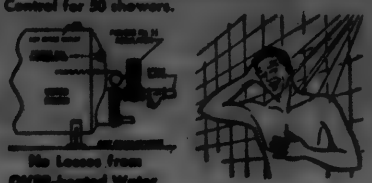
Architects: Dolli & Dolli • Engineers: W-B Engineering Co. • Contractors: W. T. Mahoney & Sons, Inc.; Htg., L. J. Keefe Co.

Quadrangle with connecting pool. Faculty building left facing south has blue porcelain enamel panels, clear glass and blue green fibre glass drapes. Chapel, in center, with plastic sky domes is connected by stained glass cloister to school building right. North exposure of the school has clear glass and gold colored fibre glass drapes.

Dramatic 70 ft. high cross at main entrance is stainless steel. Drapes behind clear glass windows are blue green fibre glass. Yellow terra cotta panels have religious insignia in black. Colors throughout the buildings including the gym are attractive.

Gymnasium type guard for thermostat

No Danger of Scalding Showers, Water Economy, too is obtained with Powers Thermostatic Control for 50 showers.



No Losses from OVER-heated Water. Hot water generator also is Powers Controlled.

# POWERS Automatic Temperature Control

## Is Used Throughout this Colorful Modern School

for the Heating and Ventilating System, Hot Water Generator and Shower Baths

Utmost Fuel Economy, Thermal Comfort and Convenience are assured here with a Powers Control System. Users often report 25 to 50 years of reliable service with a minimum of repairs.

For more than 60 years the name POWERS has stood for quality temperature control, proper installation and SERVICE if required.

Next time a problem of temperature or humidity control arises call POWERS. No other single firm makes a better line of thermostatic controls for heating, air conditioning, hot water generators and all types of shower baths.

**THE POWERS REGULATOR COMPANY**

SKOKIE, ILL. • *Offices in Chief Cities in the U. S. A., Canada and Mexico*

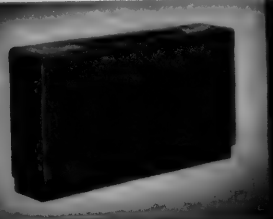
*Over 60 years of Automatic Temperature and Humidity Control*

(o29)

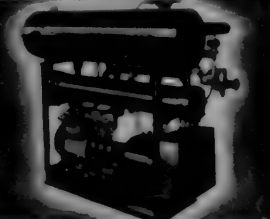
## MEET ALL AIR CONDITIONING NEEDS WITH TRANE EQUIPMENT

**NEW** model Climate Changers. Cool, heat, dehumidify, humidify, filter. Multi-Zone units provide different climates up to 8 zones.

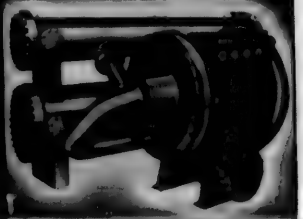
**NEW** model UniTrane Units. Room air conditioners that give personalized control of climate. Motor-fan type. Filters *all* the air.



**Cold Generator,** factory-assembled water chiller, comes ready to hook up to power, water. 10 to 100 tons.



**CenTraVac,** hermetic centrifugal water chiller, automatically modulates from 100 to 10% of capacity. 40 to 400 tons.



# stays young years longer!

## *. . . because it's engineered by Trane, built by Trane, with all these advanced features*

Long after the ordinary reciprocating compressor shows its age, you'll find your TRANE Compressor still young and healthy—doing its job efficiently, quietly, without a murmur of complaint.

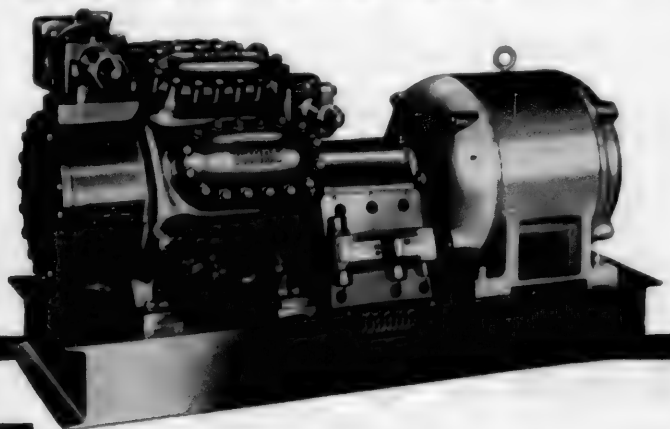
In fact, laboratory endurance tests and field performance indicate you can expect this *modern* machine to give you double the life of the average reciprocating compressor.

And it's easy to understand why, when you see how TRANE engineers have given you *all* the advanced features of this type of machine in *one* compressor—for efficiency, easy maintenance, lowest over-all cost.

### Features that help the TRANE Compressor keep its youth...

- *Dependable, multi-step capacity control that reduces starting and stopping . . . saving dollars in power costs, adding years to life.*
- *Thorough multi-cleaning of oil . . . twice filtered, centrifuged, passed over three magnetic plugs.*
- *Reversible oil pump three times needed capacity. Fail-proof oil pressure protection switch.*
- *Exclusive cadmium-plated valves that last up to 800% longer than ordinary steel valves.*
- *Exclusive "valve silencers," cushioned stops in discharge valve cage that muffle metallic "ping" of opening valves.*
- *Spring-loaded safety head that guards against liquid slug damage.*
- *Precision-made, lightweight aluminum pistons and connecting rods for smoother operation.*
- *Aluminum connecting rods provide bearing surfaces without inserts for accuracy of fit, to minimize wear.*

**All these—all modern features**—are yours only in the TRANE Reciprocating Compressor, the compressor that stays young years longer. For complete information, see your nearest TRANE Sales Office or write TRANE, La Crosse, Wisconsin.



8-cylinder model shown. Capacities 10 to 50 tons. In duplex models to 100 tons.

# TRANE

**MANUFACTURING ENGINEERS**

*One source, one responsibility for:*
*Air Conditioning • Heating • Ventilating*
*Heat Transfer Equipment*

The Trane Company, La Crosse, Wis. • Eastern Mfg. Div., Scranton, Pa. • Trane Co. of Canada, Ltd., Toronto • 90 U.S. and 17 Canadian offices

*The most convincing stamp of user satisfaction*

**ANOTHER REPEAT ORDER FOR SARCO**

Lederle's new office building at Pearl River, N. Y. will house over 700 people, is equipped with Sarco heating specialties. Architects: Eggers and Higgins. Consulting Engineers: Jaros, Baum and Bolles. Heating Contractors: Harry Hoyle Contracting Co.

# 18 years of repeat orders *and now again . . .*

## Lederle Laboratories Division American Cyanamid Co. Installs Sarco Heating Specialties

There's a good reason why Sarco Heating Specialties have been specified and used by Lederle again and again.

*That reason is Sarco dependability.*

Leading architects, engineers and contractors know from the long record of repeated user approval that they can depend on Sarco performance.

The Sarco heating specialties now operating in this new office building and other Lederle Laboratories buildings have been installed over a period of 18 years. Several thousand Sarco steam traps, radiator valves and traps, air eliminators, strainers, and temperature controls are giving satisfactory performance.

For dependable heating specialties and all around satisfaction, you can confidently specify Sarco.

On your request, we'd be happy to send you full information on Sarco's complete line.

**FOUR REASONS WHY IT PAYS TO SPECIFY SARCO**

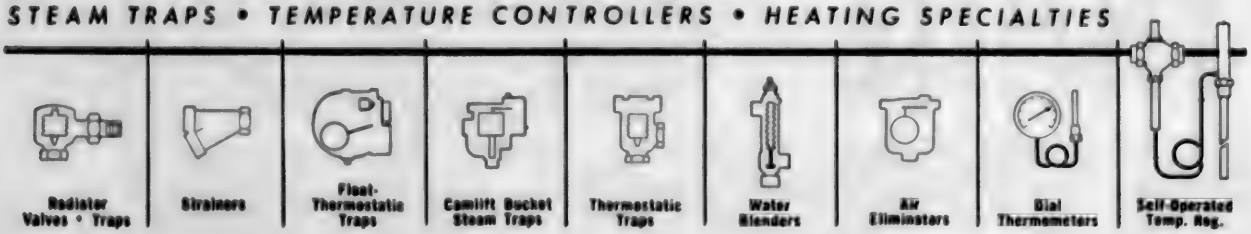
1. Proven Dependability
2. Trouble-free Service
3. Complete Line from One Reliable Manufacturer
4. Nationally Known and Preferred by Users.

2026-B

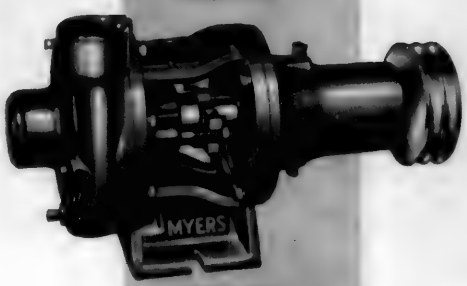
**SARCO SAVES STEAM**

SARCO COMPANY, INC., Empire State Building, New York 1, N. Y.
Sarco Canada, Ltd., Toronto 8, Ontario . . . Represented in Principal Cities

STEAM TRAPS • TEMPERATURE CONTROLLERS • HEATING SPECIALTIES



MODEL 100-S
Rotary seal only




MODEL 125-S
Shown with stuffing box
(available with rotary seal)

MODEL 100-M
Rotary seal only

MODEL 125-M
Shown with stuffing box
(available with rotary seal)

# A Complete Line of Centrifugals for Air Conditioning from

# MYERS

## tops in pumps since 1870

***FULL RANGE OF SIZES***
1/3, 1/2, 3/4, 1, 1 1/2, 2, and 3 horsepower, motor-mounted or belt-driven models.

***TWO CASING SIZES***
1" x 1 1/4" or 1 1/4" x 1 1/2".

***ALL-BRONZE IMPELLER***
Accurately balanced for smooth operation.

***REMOVABLE BRONZE WEARING RINGS***
Easily replaced for longer pump life.

***ROTARY SEAL***
Eliminates leakage (stuffing box may be specified on "125" models).

***CORROSION-RESISTANT SHAFT***
Stainless steel for trouble-free service.

***WIDE RANGE OF CAPACITIES AND HEADS***
Capacities to 90 GPM. Heads to 135 feet.

***Write today** for Bulletin 210 on Myers Centri-Thrift Pumps.*

**Myers** PUMPS WATER SYSTEMS AND WATER SOFTENERS

The F. E. Myers & Bro. Co., Dept. HV-6, Ashland, Ohio

# This 3-Way Saves Time.

ALLIS-CHALMERS EQUIPMENT FOR Air Conditioning

## 1 Coordinated Equipment

End the worry of coordinating three sources of supply. With Allis-Chalmers control-motor-drive combination, one reliable supplier guarantees the complete drive. All components are shipped from one supplier, arrive ready to be installed.

For one source . . . one responsibility, get Allis-Chalmers complete service, from power line to driven shaft.

## 2 Engineering Help

An experienced Allis-Chalmers distributor or district representative is ready to help you engineer the complete drive. This can make the job easier and more profitable for you. Components are designed to work together. One specification, one set of calculations — one order brings you the complete drive.

# ALLIS-

# Drive Combination ..Money...Trouble!

**3**

Near you there's an adequate stock of drive components commonly used in air conditioning installations. Stocks are maintained by Allis-Chalmers Authorized Distributors and Regional Offices. In addition, an efficient warehouse inventory system locates hard-to-get items within hours after you call.

There's an A-C Certified Service Shop near you, too. There are nearly one hundred independent service shops which meet strict Allis-Chalmers standards for modern equipment, efficient methods and business integrity. These shops use factory-approved parts and methods.

*Texrope* is an Allis-Chalmers trademark.

**Send for Free Engineering Literature** A-4624

**Allis-Chalmers, Milwaukee 1, Wisconsin . .**

**MOTORS**

- ☐ Handy Guide to Motor Selection 51B6052
- ☐ Squirrel-Cage Motors 51B6210
- ☐ TEFC Motors 51B7225

**CONTROL**

- ☐ Handy Guide to Starters 14B7733
- ☐ Reduced Voltage Starters 14B7215

***TEXROPE* DRIVES**

- ☐ Handy Guide to *Texrope* Drives 20B6051

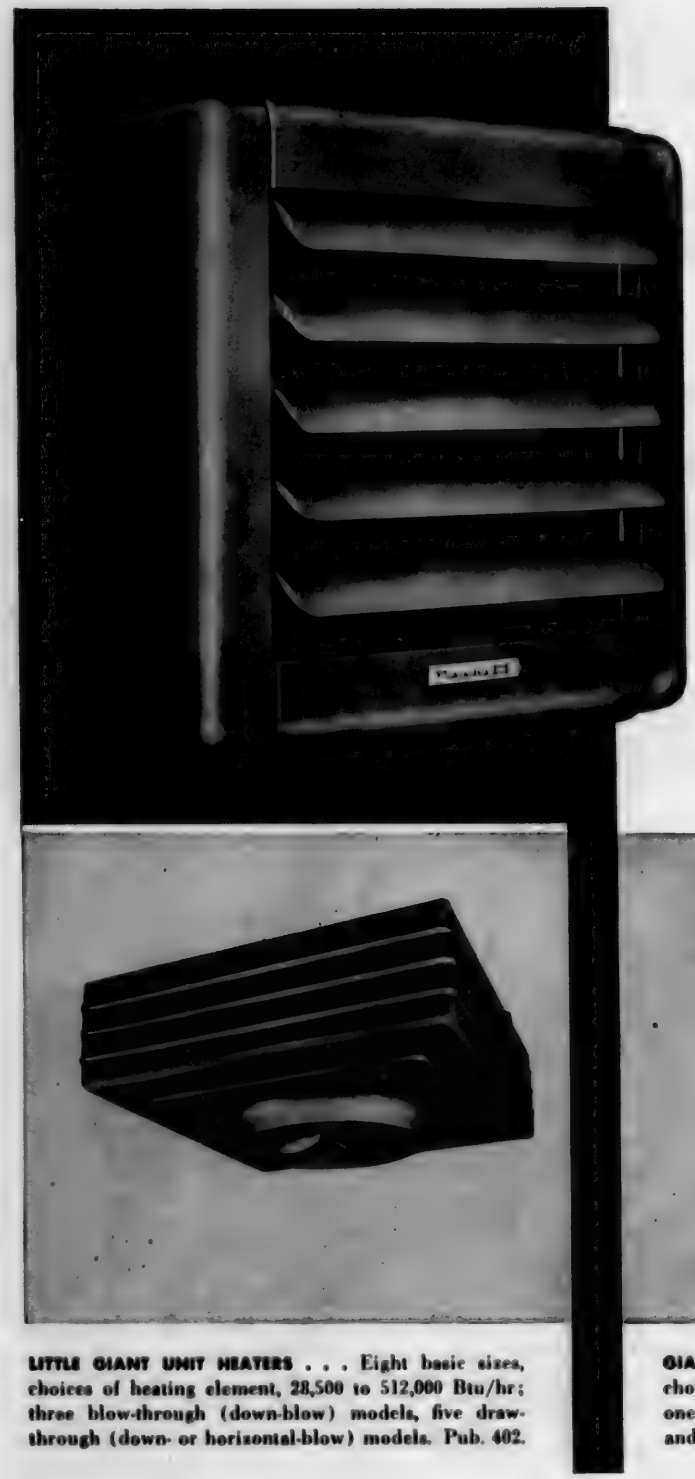
Name .....

Address .....

State .....

A-C ALLIS-CHALMERS

# CHALMERS



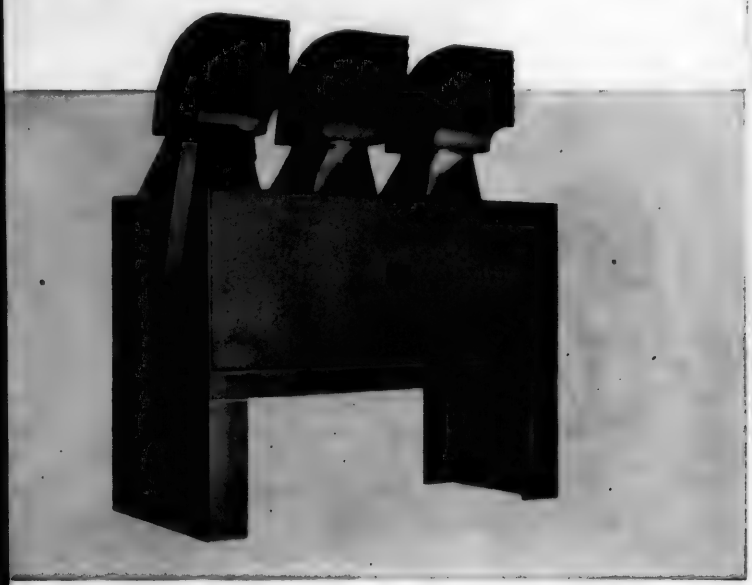
# The new

## *in the Nesbitt line*

- ★ Eight basic sizes, 24 models, 15,000 to 335,000 Btu/hr
- ★ Universal coil for maximum performance on steam or hot water
- ★ Coils made for high water capacities and temperature drops
- ★ Low water rates effect savings in piping and installation
- ★ Minimum air-flow resistance reduces noise and operating costs
- ★ Seamless copper tubes and bends; corrugated aluminum fins
- ★ Male pipe connections through casing rear save time and space
- ★ Balanced aluminum fans for quiet, large-volume air delivery
- ★ Heavy gauge, die-formed steel casings for modern interiors
- ★ Deep drawn air intake opening for maximum fan performance
- ★ Easily adjustable louvers, available with double deflectors
- ★ Green metallic hammered finish baked on bonderized steel



**LITTLE GIANT UNIT HEATERS . . .** Eight basic sizes, choices of heating element, 28,500 to 512,000 Btu/hr; three blow-through (down-blow) models, five draw-through (down- or horizontal-blow) models. Pub. 402.



**GIANT UNIT HEATERS . . .** Twelve basic sizes each with choice of ten heating elements, steam or hot water; one, two, or three fans; for large capacity heating and/or ventilating; four ways of mounting. Pub. 404.

***whenever you have a heating or ventilating problem***

# propeller-fan heater

## *of industrial and commercial unit heaters . . .*

**This wholly new Nesbitt propeller-fan unit heater offers an unusual combination of values in construction, performance, appearance and cost.**

**Its *universal* heating coil of continuous tube design *performs equally well with either steam or hot water*—an innovation that cuts inventory and warehousing costs in half.**

**Exact selection is simplified by the choice of 24 models (eight basic sizes) with capacities ranging from 15,000 to 335,000 Btu/hr. Pub. 401.**

**A careful study of the partial list of special features on the opposite page is recommended. It will explain why these new units are extremely flexible in their application, easy to install, surpassing in performance, quiet, long-lived, economical, and fit for the finest interiors.**

**The advanced styling and performance of all Nesbitt Unit Heaters is the result of over forty years of progressive engineering and technical improvement—to help keep you in the lead.**

**SERIES C UNIT HEATERS . . .** Five sizes, 34" to 74½" long, each with choice of two steam or one hot-water heating element; two to five fans; recess, semi-recess, and non-recess fronts; 35,100 to 148,000 Btu/hr. Pub. 403.

**GAS-FIRED UNIT HEATERS . . .** Seven models, 25,000 to 200,000 Btu/hr input, 400 to 2900 cfm; A.G.A. and U.L. approved for all gases; most advanced styling and many features to simplify installation. Pub. 280.

***think first of this name***

**Nesbitt**
**INDUSTRIAL UNIT HEATERS**
Manufactured by
John J. Nesbitt Inc. Philadelphia 36, Pa.

"I've never seen a sheet take every bend and roll without the coating flaking—but SOFTITE did it!"

"Fastening collars on straight boots is real severe. No sheet has ever been able to take it—but SOFTITE did it!"

"At last a sheet that can take a Pittsburgh Lock without chipping or flaking—and SOFTITE did it!"

"We've never had a sheet that combined a ductile base with a real tight zinc coating—but SOFTITE did it!"

*actual details furnished upon request.*

*...they* all said it couldn't be done–but*

# WHEELING SOFTITE®

## *galvanized sheets did it!*

Ever since Wheeling SOFTITE Cop-R-Loy Galvanized Sheets were first introduced, metal workers have been torturing the sheet with every known test and operation. And the results are consistently the same – no flaking or peeling of coating.

That's because SOFTITE combines a soft, ductile base metal with the tightest zinc coating yet produced. So tight, in fact, that the coating will take anything that the base metal will!

Put SOFTITE to any test. See for yourself why the demand for SOFTITE has forced Wheeling to triple its production facilities in 1955. Try SOFTITE once and you'll see why actual users call Wheeling SOFTITE the best galvanized sheet yet produced.

For details call the nearest Wheeling warehouse or office.

*Wheeling also manufactures a complete line of Galvanized Furnace Pipe, snap lock or closed seam Perimeter Heating or Air Conditioning Pipe, and accessories.*

Wheeling

**WHEELING CORRUGATING COMPANY, WHEELING, WEST VIRGINIA**

**For your convenience, warehouse stock immediately available at these locations: Boston, Buffalo, Chicago, Columbus, Detroit, Kansas City, Louisville, Minneapolis, New Orleans, New York, Philadelphia, Richmond, St. Louis. Sales Offices: Atlanta, Houston.**

*Galvanized steel does it better... SOFTITE does it best!*

"What should I put on the ducts?"
"Which ducts require thermal insulation?"
"What kind of acoustical treatment do ducts require?"
What are the fastest, cheapest ways to insulate ducts?"
"Do high velocity ducts require special treatment?"

# *Got any doubts about insulating ducts?*

## Write for free "HOW-TO-DO-IT" BOOKLET!

Proper thermal and acoustical treatment of ducts is absolutely vital to the success of air conditioning jobs. Recognizing the need for an authoritative "how-to-do-it" booklet, Gustin-Bacon gathered the facts and published them last year. Since that time, popular demand has caused us to reprint the booklet 4 times. It is being used by many manufacturers of air conditioning and combination units as a dealer training piece.

So don't fail to write for your free copy if you have any doubts about when, where and why to insulate ducts. It will make your job a good deal easier—and a great deal more profitable!

**WRITE FOR YOUR FREE COPY TODAY!**

This authoritative booklet has been prepared by Gustin-Bacon, manufacturers of Ultralite Duct Insulation (thermal) and Ultralite Duct Liner (acoustical). These unique insulations of long glass fibers are specifically designed for air conditioning application. In this booklet, Gustin-Bacon shares with you its know-how acquired in 10 years of service to the air conditioning industry.

For on-the-spot information and delivery of Ultralite Duct Insulation and Duct Liner, we invite you to get in touch with your local Ultralite distributor. You'll find him listed in the Yellow Pages under "Gustin-Bacon Insulations" in 57 cities and he maintains local stocks to give you prompt delivery when and where you need it.

**GUSTIN-BACON** *Manufacturing Company*

GUSTIN gb BACON

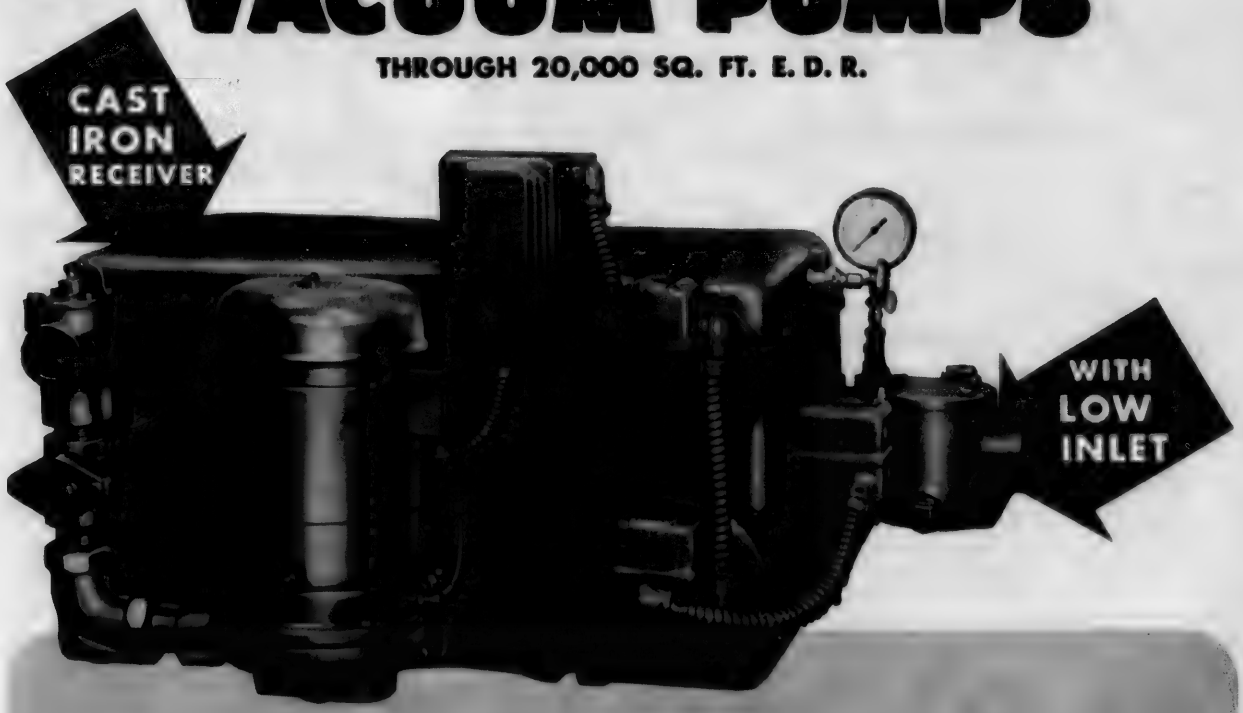
Thermal and acoustical glass fiber insulations • Pipe Couplings and fittings • Railroad gaskets and supplies

222 W. 10th St., Kansas City, Mo.

# HOFFMAN *IMPROVED DESIGN*

# VACUUM PUMPS

**THROUGH 20,000 SQ. FT. E. D. R.**




**SINGLE AND DUPLEX UNITS—RATINGS THROUGH 20,000 SQ. FT. E.D.R.**

- **HOFFMAN FAMOUS JET VACUUM PRODUCER ASSURES GREATER EFFICIENCY—LOW UPKEEP.**
- **CUTS OPERATING TIME AND POWER BILLS APPROXIMATELY ½.**
- **ENGINEERED TO REMOVE UP TO 300% OF RATED CAPACITIES OF AIR AT START OF HEATING CYCLE.**
- **SHORTER WARM-UP PERIOD MEANS ECONOMIES.**

## COMPLETE LINE OF HEATING PUMPS

**VACUUM PUMPS THROUGH 100,000 SQ. FT. E.D.R.** including units individually sized with separately controlled vacuum and condensate pumps for specific application.

**CONDENSATION PUMPS THROUGH 150,000 SQ. FT. E.D.R.** Watchman Pump—a small compact unit for systems through 8,000 Sq. Ft. E.D.R. and 20# pressure.

**CAST IRON RECEIVERS ON ALL HOFFMAN PUMPS.**

HOFFMAN Steam Specialties—Hot Water Specialties—Radiation Controls—Blake Plumbing and Drainage Products.

**HOFFMAN SPECIALTY MFG. CORP.**
1700 West 10th Street Indianapolis 7, Indiana

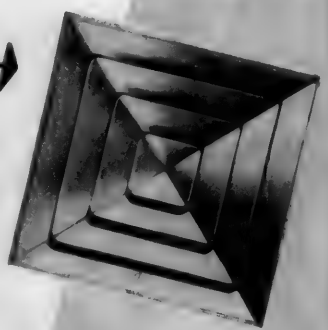
*air patterns unlimited without blank-offs*

# AGITAIR® *Custom Made*

## AIR DIFFUSERS with DIFFUSING VANES

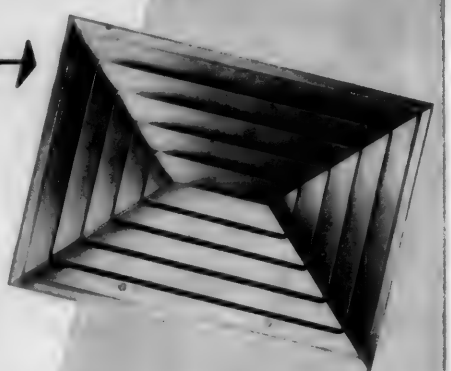
*. . . better because*

**A good piece of equipment is no better than the experience behind it.**



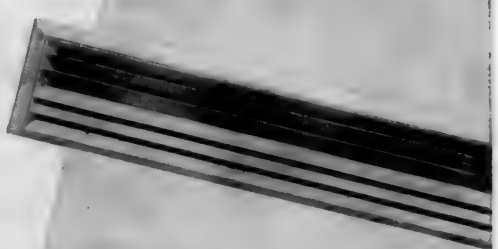
*. . . better because*

**It's the original square and rectangular outlet . . . not just a poor imitation without distinctive features.**



*. . . better because*

**The company behind these diffusers has a history for doing things right and guaranteeing results.**



## *you can depend on* AGITAIR *for better air*

*Your local AGITAIR representative will gladly assist you in selecting the proper size and air pattern to meet the requirements of your job. In addition, the engineering staff and laboratory resources of Air Devices Inc., are available to you.*

**AIR DEVICES INC.**

185 MADISON AVENUE NEW YORK 16, N. Y.

Air Diffusers • Filters • Exhausters

# Depend on B&G FOR HEATING . . . COOLING

## . . . AND PUMPING WATER

**B&G BOOSTER AND UNIVERSAL PUMPS**
**Catalog GK-954**

**Specifying "B & G" throughout for water heating systems, air conditioning and refrigeration installations assures you of equipment known for quality—with a single manufacturer's responsibility for satisfactory operation.**

**If you haven't a complete file of the B & G literature shown here, write today.**

### B&G CENTRIFUGAL PUMPS

B & G Boosters and Universal Pumps cover a complete range of heads and capacities for forced hot water heating and service water systems. Noted for *quiet* operation!

For air conditioning, refrigeration and industrial applications, B & G 1522 and 1531 Pumps have a long record for dependable and economical performance. All pumps illustrated feature the B & G Leak-proof Mechanical Seal.

### B&G EVAPORATOR

You'll find *plus value* in the unique design of this evaporator which prevents oil-trapping in the head passes. Steel legs are movable for easy mounting—shell connections extend well beyond the insulation cover. ASME Code constructed.

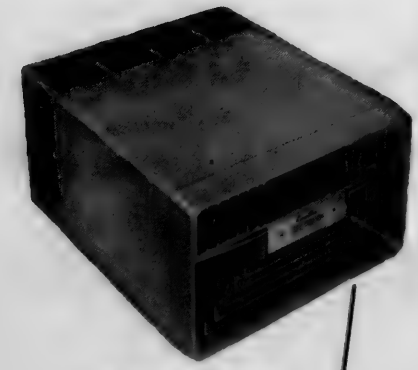
### B&G CONDENSERS

Rugged, precision-built units of time-tested design provide top performance over a long service life. Built to ASME Code.

### HEAT EXCHANGERS

Easy now to select equipment for water-to-water and steam-to-water heat transfer applications. B & G Type "SU" and "WU" Heat Exchangers are rated for instantaneous heating of water for service use—radiation—snow melting panels—swimming pools—boiler feed—storage tanks and process work. Many commonly used sizes of "SU" and "WU" Exchangers are available immediately from factory stock.

**BELL & GOSSETT**
**COMPANY**
**Dept. DX-4, Morton Grove, Illinois**
*Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto*



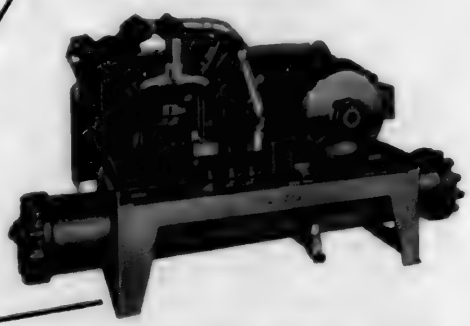
Window Air Conditioners

# More jobs... More profit!

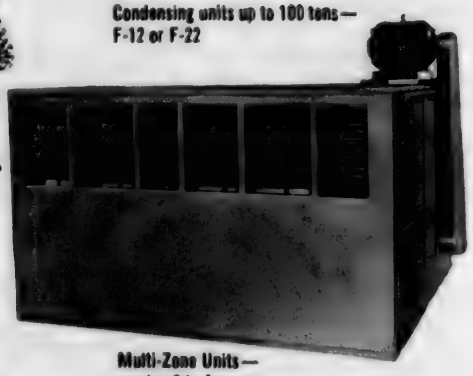
## WITH THIS

## complete Curtis LINE

Packaged Air Conditioning units—2 to 20 tons

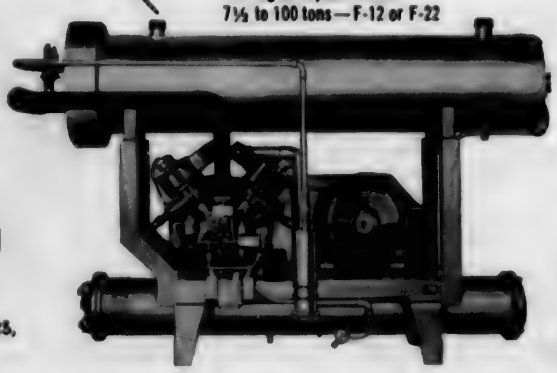


Condensing units up to 100 tons—F-12 or F-22



Multi-Zone Units—serving 2 to 8 zones

Packaged Liquid Chillers—7½ to 100 tons—F-12 or F-22

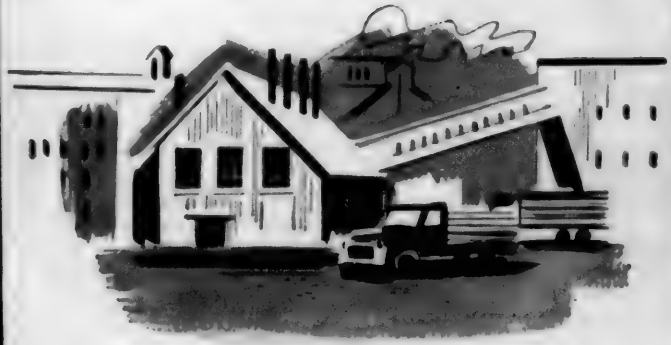


You'll sell more jobs, and make more profit, with this well-rounded Curtis line. Curtis equipment sells readily because it is backed by one of the oldest and most respected names in the business. Curtis products are presold for you by hard-hitting national advertising in *Saturday Evening Post, Time and Newsweek*, plus many national business and trade magazines.

WRITE TODAY for information on how you can obtain a Curtis direct factory franchise.

**Curtis REFRIGERATING MACHINE DIVISION**
*of Curtis Manufacturing Company*
1999 Kienlen Avenue, St. Louis 20, Missouri

*Other Curtis Products:* INDUSTRIAL AND AUTOMOTIVE AIR COMPRESSORS, AUTO LIFTS, CAR WASHERS, AIR HOISTS



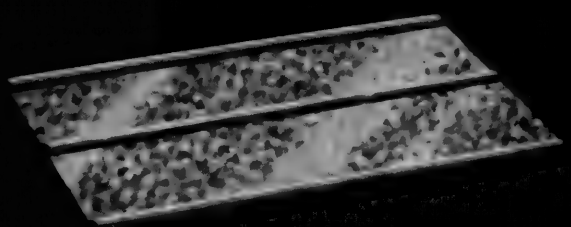
# WEIRTON

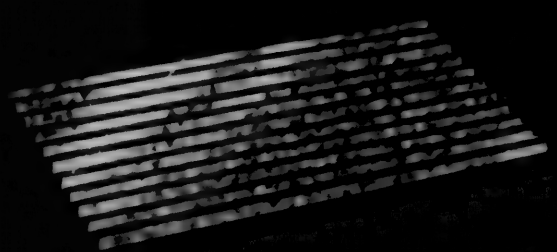
## GALVANIZED SHEETS

*for long-lived roofing and siding*

There's an easy way to solve roofing and siding problems quickly, dependably, economically. That's the Weirton way—with Weirton galvanized steel sheets. Their tight zinc coating resists cracking, peeling and flaking. The strength of steel plus the corrosion resistance of zinc gives added years of life. And long experience shows that galvanized sheets give more protection, with less maintenance and at lower cost.

Weirton's modern production processes, plus close quality control all along the line, make Weirton galvanized sheets a best buy for your roofing and siding needs.

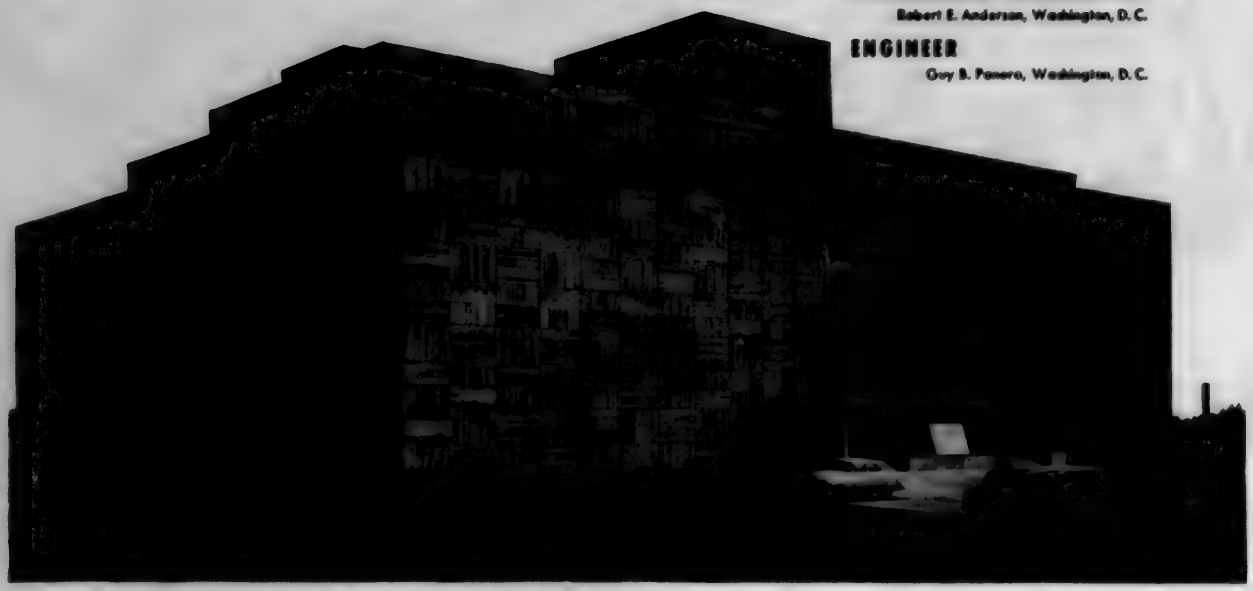




WEIRTON STEEL COMPANY

Weirton, West Virginia

NATIONAL STEEL CORPORATION



**MECHANICAL CONTRACTOR**
Robert E. Anderson, Washington, D. C.
**ENGINEER**
Guy B. Panero, Washington, D. C.

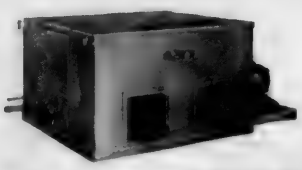
# MARLO air conditions Washington's FIRST A-bomb resistant building

The new Armed Forces Institute of Pathology at Walter Reed Army Medical Center is the first building in the Washington, D. C., area expressly designed and built to withstand an atom-bomb explosion. The 21-inch thick walls of this huge block-type structure can resist pressures up to 27.2 pounds per square inch. Specially designed "blast" doors four and one-half inches thick guard all entrances. Inside, extraordinary precautions are taken against accidents from hazardous materials used in medical experiments.

This unique building is air conditioned with Marlo equipment, including eight Spray Type Dehumidifiers with Cooling Coils, four ceiling-type Air Handling Units, 45 floor-type Remote Air Handling Units, and 78 Heating Coils.

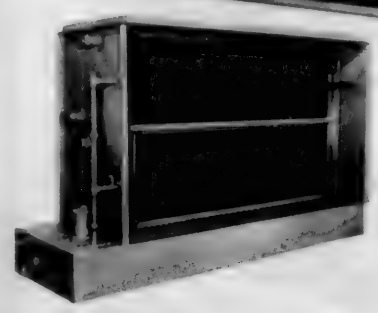
Whatever *your* air conditioning problem, you'll find the answer in the quality line of Marlo equipment. Write to Marlo today for complete information.

Heating Coil



Air Handling Unit

Remote Air Handling Unit

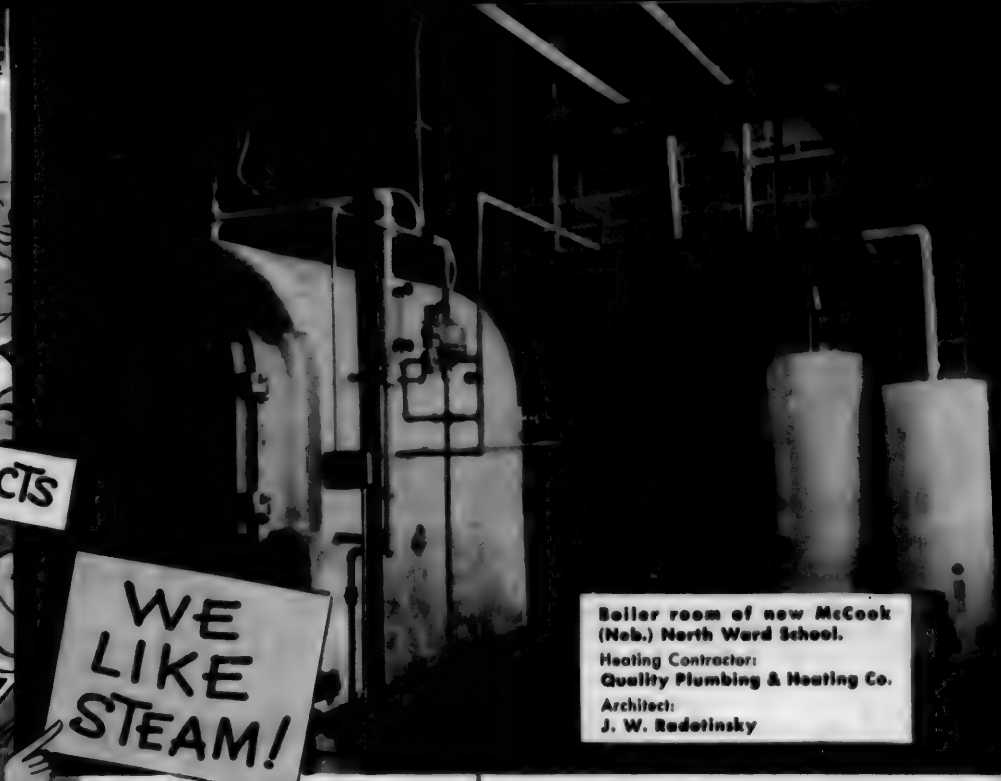


Spray Type Dehumidifier

**Marlo COIL COMPANY**

*Manufacturers of* COOLING TOWERS • EVAPORATIVE CONDENSERS • INDUSTRIAL COOLERS • AIR CONDITIONING UNITS • MULTI-ZONE UNITS • BLAST HEATING & COOLING COILS

**Saint Louis 10, Missouri**



**Boiler room of new McCook (Neb.) North Ward School.**
Heating Contractor:
**Quality Plumbing & Heating Co.**
Architect:
**J. W. Radotinsky**

# They're on the March for Steam!

Like the folks at party caucuses, heating engineers have been known to have some sharp differences of opinion . . . but there are still plenty of experienced men casting their votes for steam.

Particularly in schools and institutions that old campaigner, steam, is going strong. One of the many examples of this is the plant in the recently constructed North Ward School at McCook, Nebraska. The gas-fired DM-61 Fitzgibbons boiler which heats this modern school is pictured here. It was installed by Quality Plumbing & Heating Co. The architect is J. W. Radotinsky.

Very much in the picture is the safety provision always found in a well engineered job — the McDonnell Boiler Water Level Control. The control installed here is the McDonnell No. 247-2 combined boiler water feeder and low water cut-off. It is the standard No. 47-2, illustrated opposite, without Quick-Hook-Up fittings. Instead of being installed in the gauge glass tappings, one-inch equalizing pipe is used on boilers of this kind which have independent water columns.

Yes, water level control gets an almost unanimous vote for all the new steam jobs, but there are still hundreds of older steam plants that do not have low water protection . . . and need protection even more! Are you going after this profitable business?

**McDONNELL & MILLER, INC.,** 3500 N. Spaulding Ave., Chicago 18, Ill.

*Doing One Thing Well*

## McDonnell No. 47-2

No hand-fired steam boiler should be without the No. 47 Boiler Feeder — no automatically - fired boiler without the No. 47-2 feeder cut-off combination. Constantly improved year after year, the No. 47 is the last word for boilers up to 5000 sq. ft. capacity; maximum steam pressure, 25 lbs. Other types for larger and higher pressure boilers.

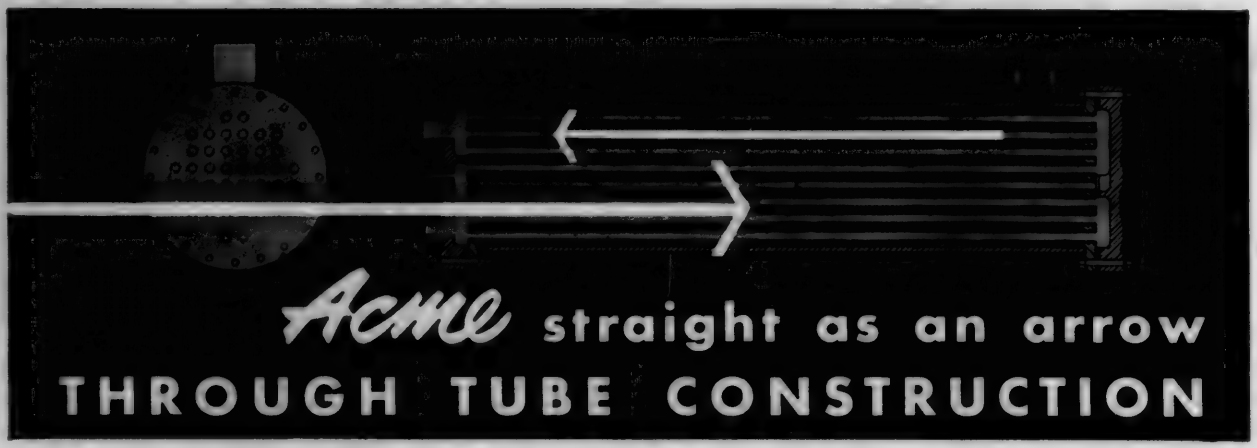
## McDonnell No. 67

Next best thing to the No. 47-2 for the automatically - fired boiler is the No. 67 Low Water Fuel Cut-off. It is for boilers of any size, maximum pressure, 20 lbs.

## McDonnell No. 150

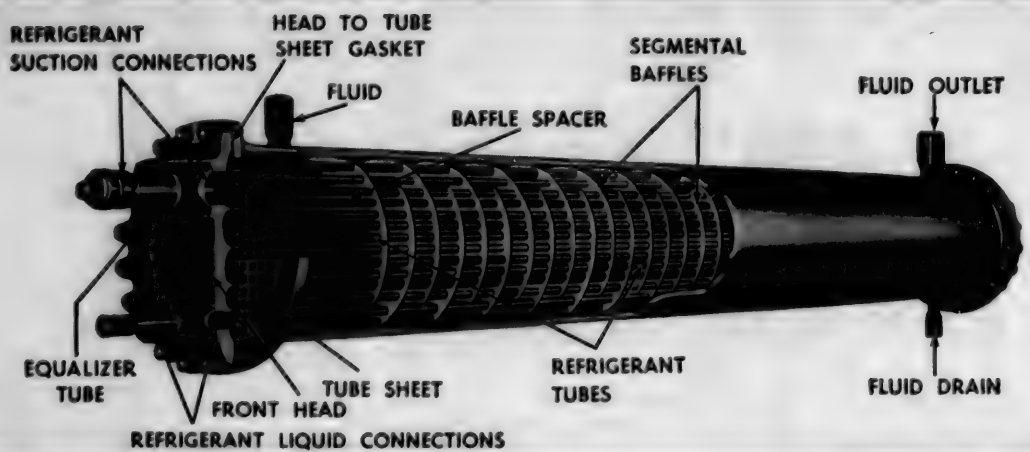
For those higher pressure boilers (maximum, 150 lbs.) the No. 150 is the answer. It controls the feed pump directly from the boiler water level; also provides low water fuel cut-off and low water alarm when desired. Same control made with integral water column for easy installation — the No. 157.

# McDONNELL ...ter Level Controls



# Acme straight as an arrow THROUGH TUBE CONSTRUCTION

## one reason why you should specify Acme DRY-EX® LIQUID CHILLERS for efficient performance




The straight as an arrow full size tubes of Acme-originated Dry-Ex Liquid Chillers have no curves, no bends, no welds. With multipass heads at each end of the tubes, a clear, unobstructed passage is provided for high velocity flow of refrigerants. The above features provide maximum heat transfer area for guaranteed efficiency and compactness. Oil return is positive. Refrigerant tubes are cleanable. Individual tubes *can* be replaced if rupture is ever caused through system control failure.

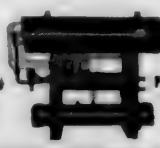
Other features include factory specified baffle spacing to fit job requirements exactly. Cast steel refrigerant heads are stocked in a range of perfected pass designs to solve all types of single and multiple-circuit needs.

Dry-Ex Chillers are made in 1 to 200 ton capacities, with over 700 baffle and shell combinations available. Acme, original manufacturer of direct expansion type chillers 18 years ago, produces more Dry-Ex type liquid chillers than all other manufacturers combined.

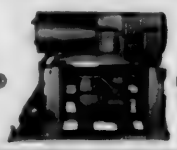
**Dry-Ex is Serving Firms Like These —**

Bell & Howell Co.
Libby-Owens-Ford
Santa Fe Railway Co.
Johns Manville
Bohn Aluminum & Brass Corp.
Container Corporation
Minneapolis-Honeywell
Giddings & Lewis
Gates Rubber Co.
Raytheon Co.
Ohio Edison Co.

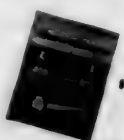
Acme Cooling Towers and Evaporative Condensers



Flow-Therm® Packaged Liquid Chillers



Flow-Cold® Packaged Liquid Chillers



*Write for new Acme Dry-Ex Catalog.*

WORKING WITH ARCHITECTS, ENGINEERS AND MANUFACTURERS ON AIR CONDITIONING AND REFRIGERATION SINCE 1919

**ACME INDUSTRIES, INC.**

JACKSON, MICHIGAN

WHY IT PAYS TO DO BUSINESS WITH THE LEADER

Tube Turns' nearby complete stock SAVES YOUR PURCHASING TIME

Tube Turns' pioneering research GIVES YOU ADVANCED PRODUCTS

Tube Turns' engineering help GIVES YOU COST-CUTTING IDEAS

# How you get *more for your money* with our stainless steel fittings

THE ANSWER to many piping problems (such as corrosive conditions) is found with stainless steel. For these applications too, you'll find it pays to buy "TUBE-TURN"*.

The *complete line* of TUBE-TURN Stainless Steel Welding Fittings and Flanges includes AISI Types 304, 304 L, 347 and 316 . . . thin wall and heavy wall . . . to match your needs. They give you these extra values at no extra cost: Meet *all* code specifications . . . Have greater uniformity of wall thickness . . . Match bursting strength of pipe. You can simplify purchases by ordering them *from your nearby Tube Turns' Distributor* on the same order with other TUBE-TURN Welding Fittings and Flanges . . . the world's most complete line.

*TUBE-TURN Welding Fittings and Flanges are made in U.S.A. They meet all U.S. piping code specifications.*

**TUBE TURNS** LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Denver • Los Angeles San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

*"TT" and "TUBE-TURN" Reg. U. S. Pat. Off.

**Comfort story of new 24-floor building—the Second National Bank of Houston**

# Honeywell Electronics saves

*The Second National Bank building of Houston, now under construction, will have the world's most advanced temperature control system—Honeywell electronic.*

# thousands of dollars

## Central control room is key to more efficient temperature control

THE NEW ERA of electronic efficiency and comfort is coming of age in the southwest. Completion of the new home of the Second National Bank of Houston sometime next year will mark an important step in this era.

The reason for the new efficiency in the Second National Bank is the master control center. Here, a single operator has at his finger tips control over temperatures throughout the 24-story building.

The reason for the new comfort is the flexibility and fast response of the electronic controls. The purpose is to create for the client a more productive environment where people feel, think, and work more energetically and efficiently.

Strategically placed Honeywell thermostats will compensate for every possible occupany, exposure and use comfort factor. The thermostats concealed in ducts will control 318 individual comfort zones, making the new building super-comfortable for employees, clients and tenants.

The *techniques* used in solving these comfort problems can help you provide the Indoor Weather required for your clients' facilities—for a Honeywell Electronic Customized Temperature Control installation is *designed to fit the needs of the building and its occupants.*

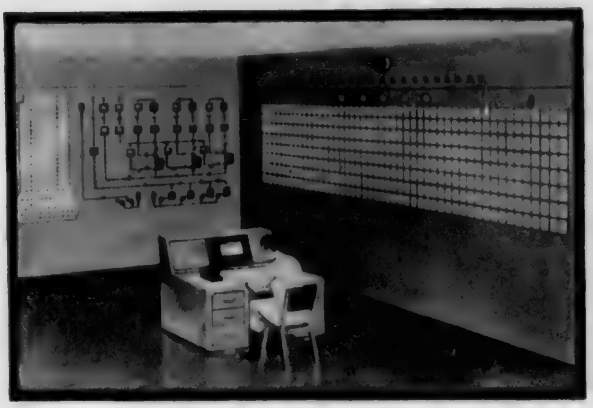
**For comfortable, more productive temperature in new or existing buildings—of any size—specify Honeywell Electronic Temperature Control**

Whether it's a bank, office, church, school, motel, hospital, factory—any building of any size—new or existing, flexible Honeywell Electronic Customized Temperature Control can help meet your clients' heating, ventilating, air conditioning and industrial control problems.

Your clients have more comfort, efficiency and maintenance economy—and they'll save fuel, too.

For full facts on Honeywell Electronic Customized Temperature Control, and the economical Honeywell Periodic Maintenance Plan, call your Honeywell Office. Or write Honeywell, Dept. HV-6-76, Minneapolis 8, Minnesota.

*Kenneth Franzheim, architect.*
*H. E. Bovay, Jr., consulting engineer.*
*Ray P. Taylor, engineering consultant.*
*W. S. Bellows Construction Corporation, general contractor.*
*Straus-Frank Co., mechanical contractor.*



**Master Control Center gives quick service to tenants and reduces daily building operating costs.**

Proudly displayed before the public on the first floor of the building will be the master control center. The Colorgraphic panel at the rear shows at a glance and records the operating conditions of the basic heating and air conditioning plant, to insure peak efficiency and economy.

A single operator can maintain complete control over the entire heating and cooling system. On his desk, he can read the temperature at 318 key points throughout the building. At the panel on the right, he can adjust any of these temperatures to suit the individual's exact requirements. Ventilation in any area can also be adjusted for maximum economy and comfort.

With this master control center, maximum service is given to the building occupants at a minimum cost. Many thousands of dollars are saved by eliminating trips through the building to check temperatures and adjust thermostats. Only Honeywell can provide this coordinated electronic control and recording system.

**Without Honeywell Electronic Control, 318 check points**

318 points would have to be checked at the thermostat.

**With Honeywell Electronic Control, 1 check point**

An operator at a panel will be able to check and *adjust* all 318 remotely.

MINNEAPOLIS **Honeywell**

**Electronic Controls**

*112 offices across the nation*

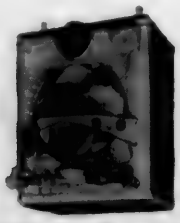
# There's a **Reznor** Gas Heater for Every Engineered Heating Job

## Gas Unit Heaters

**self-contained, completely automatic units for production and distribution of heat at the point of need.**

Wherever you go you'll find Reznor heaters proving their versatility in all types of commercial, institutional and industrial buildings from tiny shops to huge factories and warehouses.

There are two reasons why nearly 50% of the gas unit heaters sold today are made by Reznor — engineering leadership and fine construction. Both have been Reznor traditions since the first Reznor heaters were made, in 1888. An aggressive research and production development program has kept Reznor ahead of the field with improvements for greater comfort or more heat per fuel and equipment dollar. And Reznor's high standards of workmanship and materials mean greater efficiency and longer life.



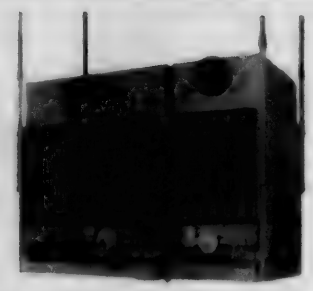
Propeller Fan Type Suspended Units—nine sizes; 25,000 to 250,000 BTU.

Blower Type Suspended Units—for use where quiet operation is a must — eight sizes; 25,000 to 200,000 BTU.

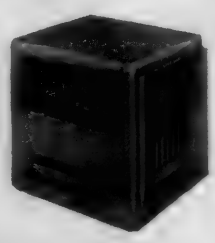
The New Reznor Twin Fan 250,000 BTU Model — another first for Reznor engineering.

Console-Styled Floor Models—for offices, stores and homes—three sizes; 25, 50 and 75 thousand BTU.

## Two NEW Duct Furnaces



**SERIES DS** — Systems with capacities in excess of two million BTU can be assembled, on the job, out of the four basic DS sections. Section capacities are 150, 200, 250 and 300 thousand BTU. The largest single section weighs only 315 pounds. Each section complete with combustion controls and built-in-draft diverter



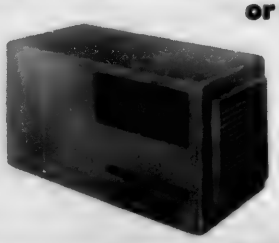
**SERIES D** — Four sizes; 50, 75, 100 and 125 thousand BTU — compact, handsomely-styled units are complete with combustion controls and built-in draft diverter

### for use in custom engineered heating and air conditioning systems

These two new models, though varying greatly in details of design and construction, have the same advantages of high efficiency and easy installation as an integral part of the duct system. And both offer complete flexibility for combination with components for air-moving, cooling, cleaning and humidification chosen to meet the exact requirements of each job.

## The Reznor PAC

### compact horizontal furnace or deluxe unit heater



Compact design and appliance styling make the PAC ideal for crawl space and attic applications in residential heating or for suspended installations in basement, utility room or kitchen.

Used without ducts, the PAC becomes a deluxe unit heater which meets the most exacting requirements for cleanliness, quiet operation and fine styling.

**REZNOR**
THE WORLD'S LARGEST SELLING GAS UNIT **HEATERS**

Reznor Manufacturing Co.
64 Union Street, Mercer, Pa.

**UNION CENTRAL** Annex Building, Cincinnati, utilizes some 200 Kno-Draft High Pressure Air Diffusers for quiet, draftless, comfortable air distribution.

**BEHIND THE SCENES** photo shows typically compact Kno-Draft single-duct system. Note flexible connectors. Outlets at same level as ducts explain why...

# High Pressure Saves Space

Space saving, of course, is only one advantage of high pressure air transmission. But it's important. High building costs make it worth while to reduce space allotted to air ducts; and in existing structures, small high pressure ducts have permitted central system air conditioning where space limitations prohibited conventional designs.

Additional advantages of Kno-Draft high pressure systems are: (1) flexibility to meet changes in air conditioning requirements without modifying the system, and (2) individual room temperature control from central station systems.

Kno-Draft High Pressure Air Diffusers are especially designed to handle air at branch duct velocities up to 3,000 feet per minute. Outlets are equipped with dampers and sound traps to eliminate noise. System provides even temperatures throughout the area *without drafts.*

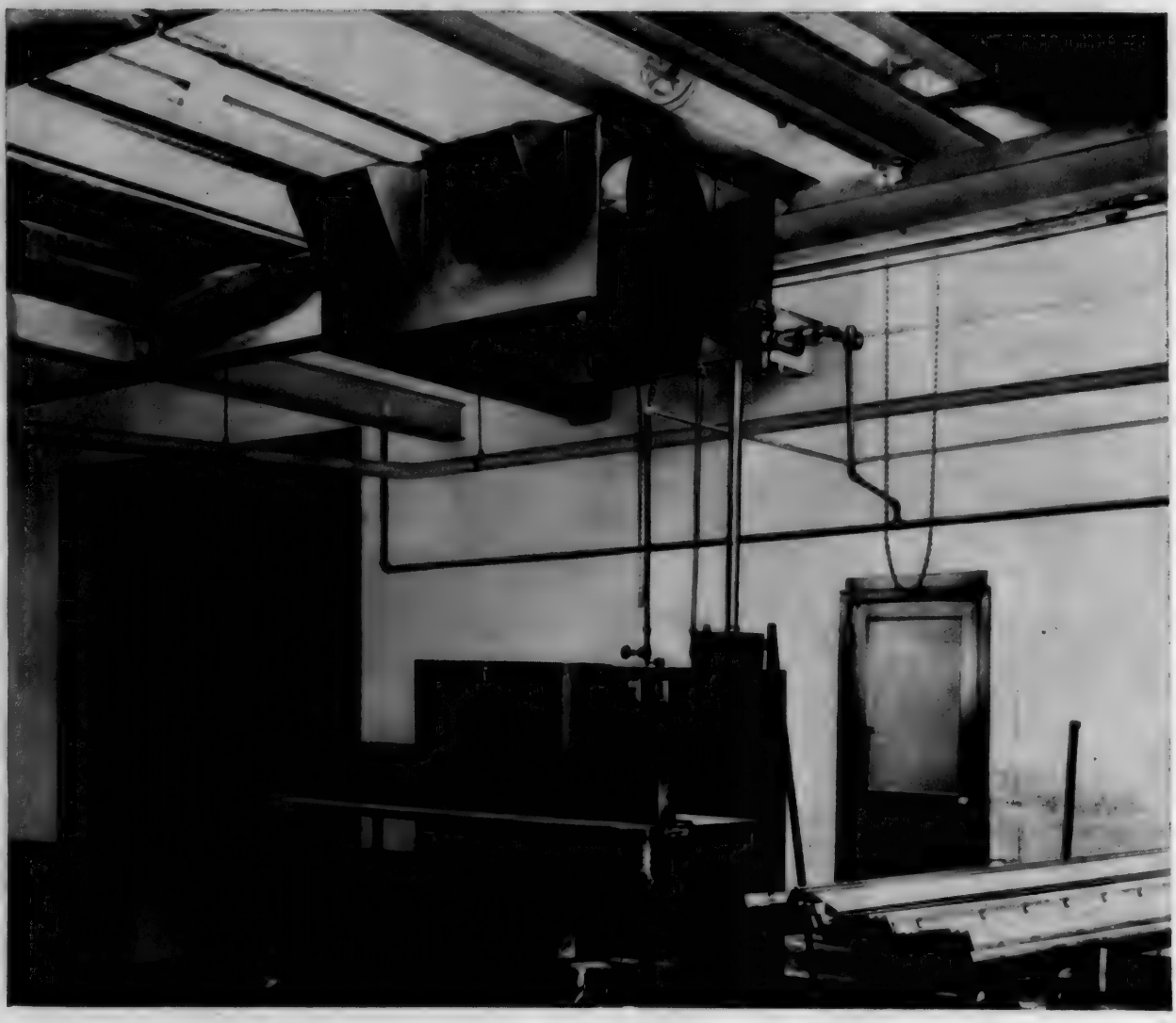
For a full description of Kno-Draft High Pressure Air Diffusers and layouts for typical systems, read the Connor textbook on the subject. Write on your letterhead for a copy of Bulletin K33. Connor Engineering Corporation, Dept. J-65, Danbury, Connecticut.

CONNOR

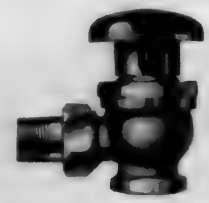
**kno·draft®**

**adjustable air diffusers**

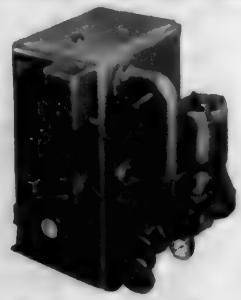
# New Dunham Blower Unit Heaters...



**From radiator traps**
**to fully engineered systems**
**you can DEPEND ON DUNHAM for**
**everything you need in heating**

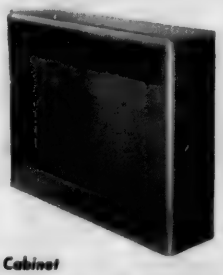


**Dunham Radiator Valves.** Complete line of radiator valves, traps and other specialties for steam heating.

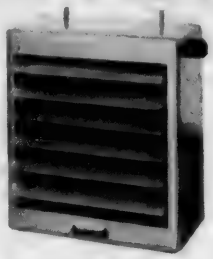


**Dunham Vacuum Heating Pumps.** Single and Duplex models. No close clearance parts. Only one moving element.

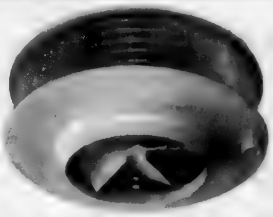
# in types and capacities to fit every need



*Dunham Cabinet Unit Heaters* for steam or hot water, capacities from 10,000 to 108,000 BTU.



*Dunham Horizontal Discharge Unit Heater,* for steam or hot water, capacities from 10,600 to 360,000 BTU.



*Dunham Vertical Discharge Unit Heater,* for steam or hot water, capacities from 26,000 to 576,000 BTU.

Dunham's newly redesigned line of blower unit heaters is one of the most broad and complete in the industry. Seventeen different sizes . . . in 170 ratings from 125,000 to 1,500,000 BTU . . . 1,430 to 20,800 CFM.

Dunham Blower Unit Heaters can be mounted on ceilings, walls or on floors. They solve any heating, ventilating, air cleaning, process heating or drying problem. A wide variety of nozzle and nozzle-extension arrangements lets you "pinpoint" or widely diffuse warmth where needed. Heaters can be used with or without ducts . . . with bypass damper, filter section and mixing dampers to handle any of your client's usual . . . or unusual . . . space or process heating and ventilating requirements.

***And For Spot Heating,*** Dunham offers an unusually complete line of propeller fan unit heaters . . . cabinet types for floor- or wall-mounted installations . . . horizontal and vertical discharge heaters for overhead applications. For full information, write for Bulletin ACHV-6, C. A. Dunham Company, 400 W. Madison St., Chicago 6, Illinois.

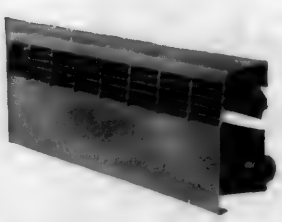
DUNHAM

## HEATING & COOLING EQUIPMENT

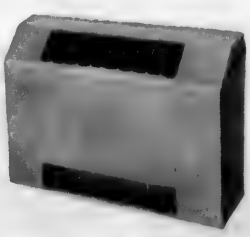
RADIATION • CONTROLS • UNIT HEATERS • PUMPS • SPECIALTIES

*Quality First for Over Fifty Years*

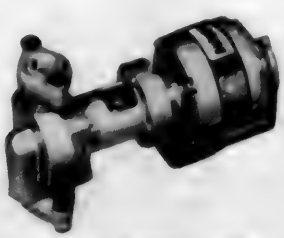
C. A. DUNHAM COMPANY • CHICAGO • TORONTO • LONDON



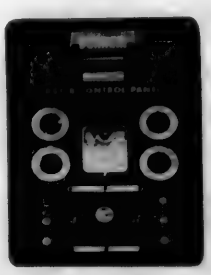
**Dunham Radiation.** Full range of sizes and types of convectors, baseboard and finned tube radiation.



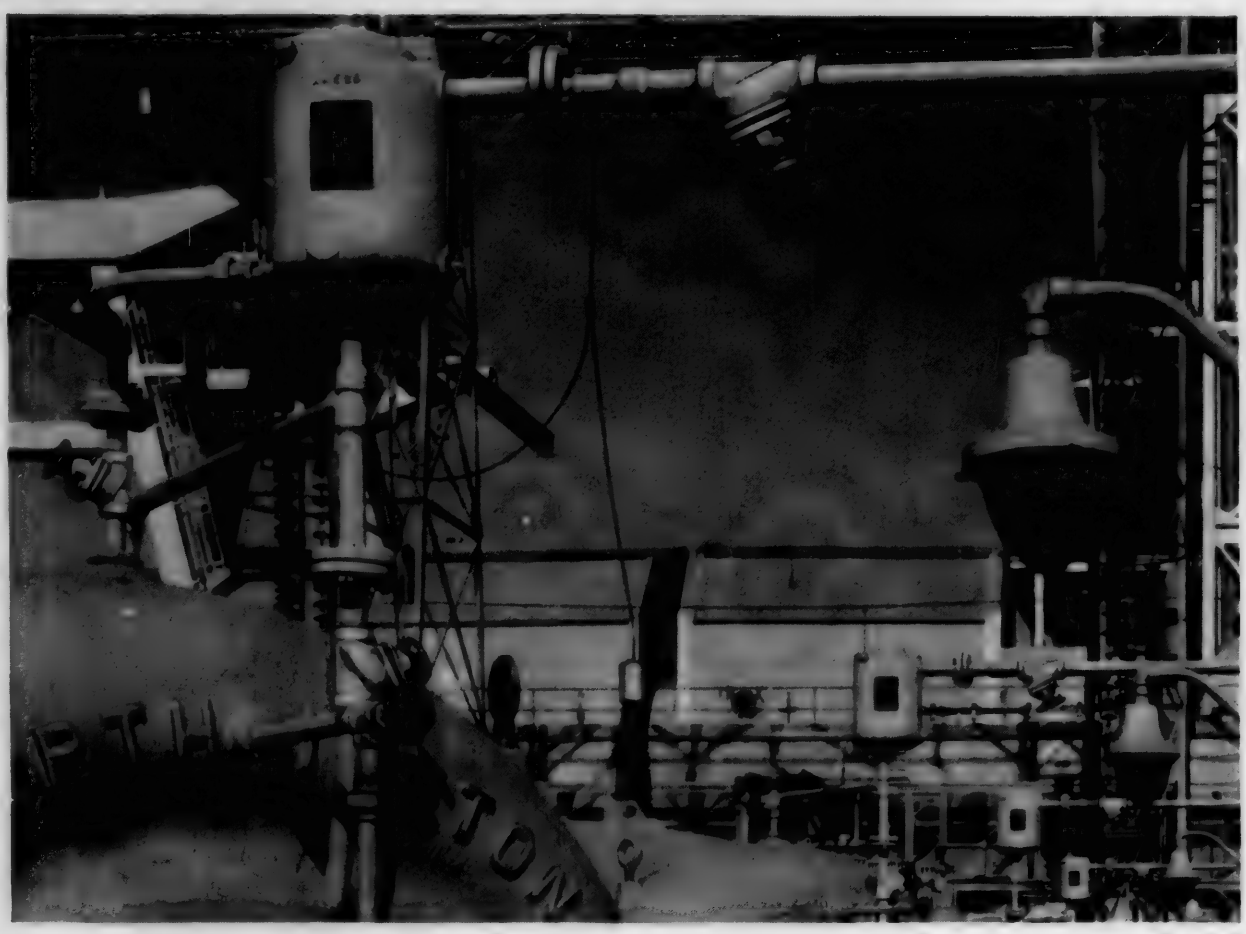
**Dunham Unit Heaters.** Line includes heating-cooling units, vertical, horizontal discharge and large blower unit heaters.



**Dunham Circulators.** Heart of Dunham's complete hot water line. Single-spring motor coupling. Brand-name motor.



**Dunham Vari-Vac®.** Precision temperature control system uses continuous-flow "cool" steam, cuts fuel costs up to 40%.



# Corrosive circulating water tamed here by these CRANE VALVES

**THE CASE HISTORY**—Almost 2 years' operation without any maintenance of valves on circulating water lines to condensers, and on priming and instrumentation systems—with no trouble in sight. That's the experience of Southern California Edison Company's 280,000 k.w. steam station at Etiwanda with Crane Packless Diaphragm Valves.

The plant's engineers knew that sediment in recirculated water would quickly cut out the seats in ordinary valves and its corrosive elements would attack working parts to make valve operation difficult.

Not so with Crane Packless Diaphragm Valves. Their sealed bonnet keeps working parts out of contact with line fluid—free of corrosive effects. Separate disc construction with pliable insert resists erosion—seats tightly even on foreign particles. Large or small, these valves operate easily with fewer turns to the cycle. Typical Crane quality throughout—they're made better to do the job better—a bigger value for the thrifty buyer.

**CRANE No. 1610 PACKLESS DIAPHRAGM VALVES**

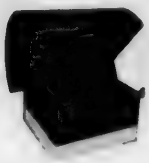
No packing to maintain. Neoprene diaphragm has longer life because it seals the bonnet only—is not subject to the cutting and crushing encountered when also required to do the seating. Separate disc gives control of fluid even should diaphragm fail. Wide selection of materials and sizes. Write for folder AD-1942 or see your Crane Representative.

# CRANE CO.

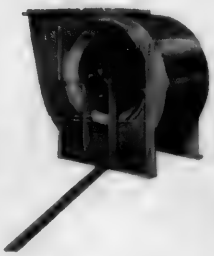
*General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
*Branches and Wholesalers Serving All Industrial Areas*

**VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING**

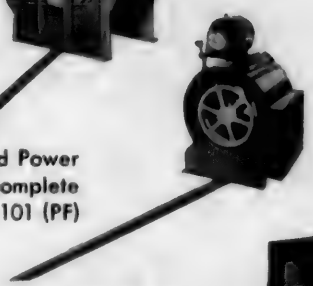
**CRANE'S FIRST CENTURY . . . 1855-1955**



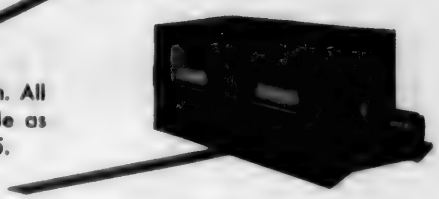
## OUR 76TH YEAR



**POWER ROOF VENTILATORS,** Propeller Fan Type and Power Fixed (backward curve blade) offer a wide range of sizes. Bulletin No. 119 Propeller Fan Type Bull. 124 Power Fixed Fan Type.



**BLOWERS,** Squirrel Cage (Forward Curve) and Power Fixed (Backward Curve) Fans available in a complete range of sizes, Single or double width. Bulletin 101 (PF) Bulletin 105 (S.C.).



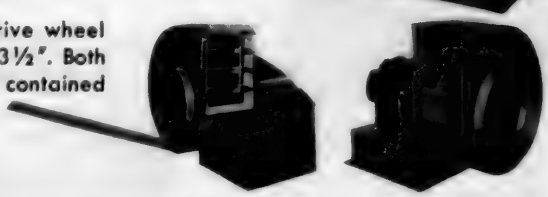
**FURNACE FANS,** Single, double or special width. All housing and wheel parts are die formed. Available as complete assemblies or parts only. Bulletin No. 115.

**UNIT HEATERS,** Blower Type floor or ceiling mounting arrangements, built in sections to facilitate efficient handling and erection. Popular sizes. Bulletin No. 112.

**PROPELLER FANS,** New Venturi-type Belt drive 24" to 48" wheel diameters, direct drive 12" to 30" diameters. A complete line of accessory items are available. Bulletin 117.

**UNIVERSAL BLOWERS,** A stock blower assembly made in single or double width, sizes 7" to 27" wheel dia. and features Universal discharge arrangement. Bulletin No. 110.

**AIR CONDITIONING UNITS,** Seven sizes available, ranging from 1,000 to 14,000 C.F.M. Vertical or horizontal mounting. Designed to combine cooling in summer, heating in winter. Bulletin 120.



**VENTILATING SETS,** Utility type. Belt drive wheel diameters 7" to 30". Direct drive 6" to 13½". Both available in popular competitive sizes, self contained completely packaged units. Bulletin 109.

# The BISHOP & BABCOCK Mfg. Co.

# multi-vent®

## the only ceiling air diffuser in the world that can be completely concealed!

Quick, easy installation and ready accessibility for adjustment or maintenance.

Cafeteria Area of the Employers Mutuals of Wausau, Illinois Regional Office, River Forest, Illinois. Shaw, Metz & Dolio, Architects & Engineers. Schiess Construction Company, General Contractors.

**Complete concealment,** in metal pan ceilings, is only one of the many reasons Multi-Vent is specified to distribute conditioned-air in modern buildings.

**Complete concealment** means that there are no protruding or exposed outlets to present problems in symmetry or in architectural effect.

**Complete concealment** means complete freedom of partition movement. This is possible due to the low injection velocity with which air is diffused from Multi-Vent panels. Partitions can even bisect these panels with no serious "blow" or "throw" being encountered.

**Complete concealment** of both supply and return panels is also possible when cooling only is desired.

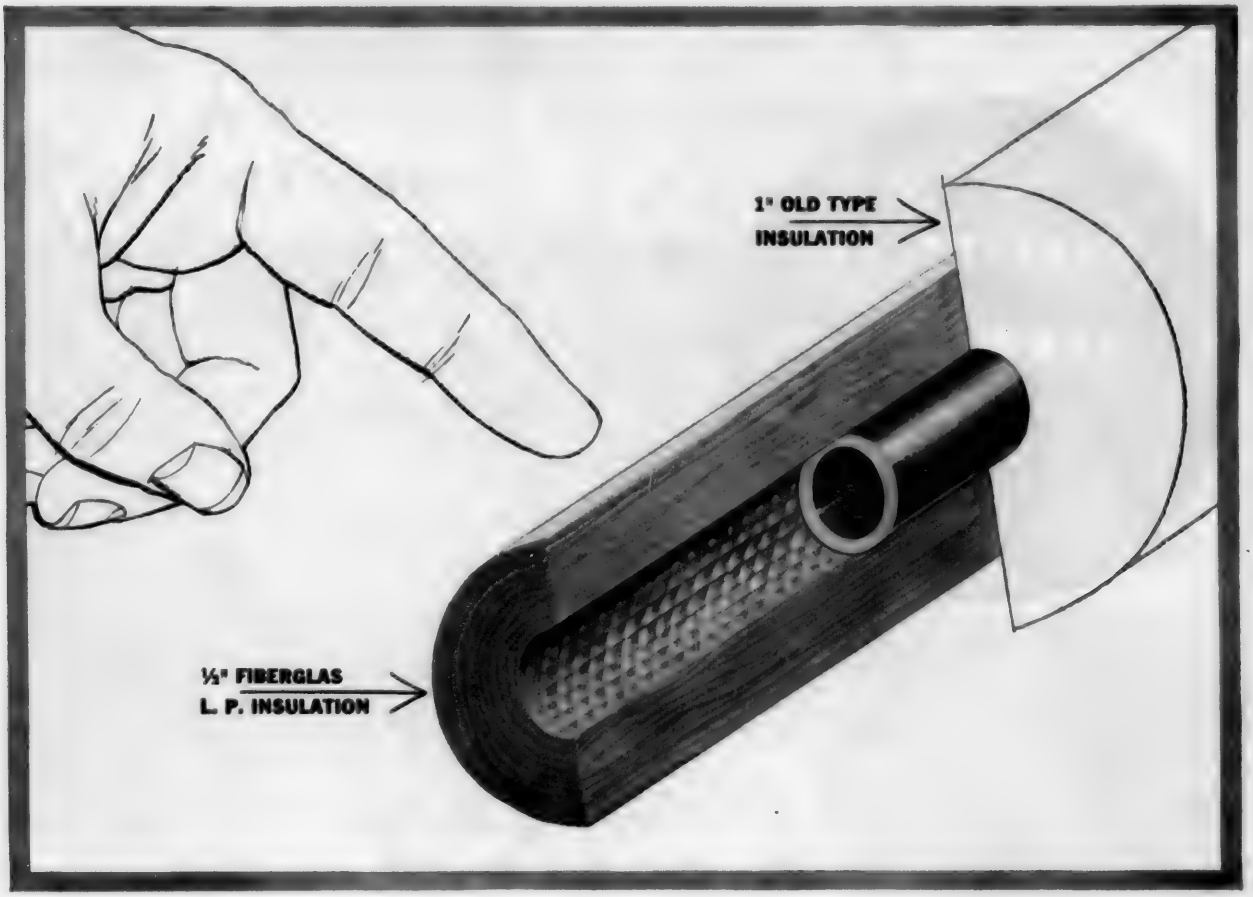
- **Complete freedom of Partition Movement.**
- **No deflection problems to restrict panel location.**
- **Exceptional uniformity of temperature.**
- **More room air-changes per hour without drafts.**
- **Elimination of dirt impingement on ceiling.**
- **No protruding outlets.**

**Literature furnished upon request**

**multi-vent** DIVISION OF / **THE PYLE-NATIONAL COMPANY**
WHERE QUALITY IS TRADITIONAL

1374 North Kostner Avenue, Chicago 51, Illinois

SALES AND ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES OF UNITED STATES AND CANADA




*Now less does more!*

# NEW FIBERGLAS* LOW PRESSURE PIPE INSULATION

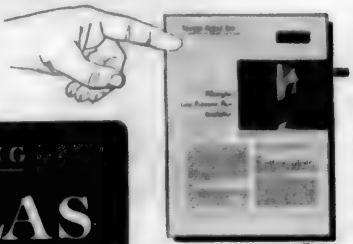
## Rot-proof · Shrink-proof · Unsurpassed in Thermal Efficiency

Here's the first major improvement in low pressure pipe insulation in 30 years! A moisture-resistant, rot-proof, shrink-proof, no-sag insulation for low pressure steam pipes, and hot and cold water lines! A lightweight, easy to handle insulation with exceptional thermal efficiency! One-half inch of this new Fiberglas L. P. Pipe Insulation saves as much heat as one inch of many old-type insulations! Saves space, too, and offers less surface needing painting.

You'd expect this "pipe dream come true" to cost more. Actually it's priced right in line with less efficient insulations. Through the years it pays for itself over and over again.

For better jobs at no extra cost, switch to Fiberglas L. P. Pipe Insulation. You'll find full data on sizes, factory-applied vapor barriers, application, thermal efficiency, etc., in our new technical bulletin. Send coupon today and get your copy without delay.

**THIS BULLETIN TELLS THE FACTS**



OWENS-CORNING
FIBERGLAS

*T. M. Reg. U. S. Pat. Off.

PIPE INSULATIONS • ROOF INSULATIONS • DUCT INSULATIONS
EQUIPMENT INSULATIONS • LOW TEMPERATURE INSULATIONS

Owens-Corning Fiberglas Corporation
Dept. 41-F, Toledo 1, Ohio

Yes, I'd like to have the facts about Fiberglas L. P. Pipe Insulation. Please send your technical bulletin.

Name.....
Title.....
Company.....
Address.....
City.....Zone....State.....

# JENN-AIR **LOW-CONTOUR** exhausters

**66 Distributors—Coast-to-Coast—Insure Fast Delivery and Service**

In these days when speed's the need in building, it's good to know you can depend on fast delivery and service with Jenn-Air Low-Contour Exhausters . . . 66 distributing offices coast-to-coast mean over-night service anywhere in the U. S. A. And since Jenn-Air is the largest manufacturer of wall and roof exhausters in the commercial ventilation field, you can specify with confidence when you select Jenn-Air. So, if you're faced with a close building schedule, select Jenn-Air, and be assured your ventilating installation will be made on time and in time.

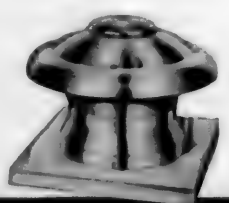
**Jenn-Air, First with Low-Contour Exhauster Design**

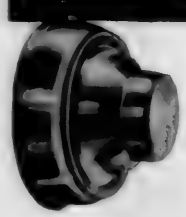
Jenn-Air is the originator of truly "low contour" exhauster design. In considering contour, two levels are important; the discharge level height, which must be sufficient to be above snow or blowing rain, and the over-all level height, which should be low enough to provide true low contour.

Jenn-Air Roof Exhausters with the nesting feature (power assembly nested into base of unit) give a high point of discharge near the top of the unit and still retain the lowest possible contour. In addition Jenn-Air provides a pleasing architectural effect. Write for the name of your closest Jenn-Air distributor.

**Jenn-Air — World's Largest Producer of Commercial Wall and Roof Exhausters**

*Low-contour Roof Exhausters blend with architectural design of building*





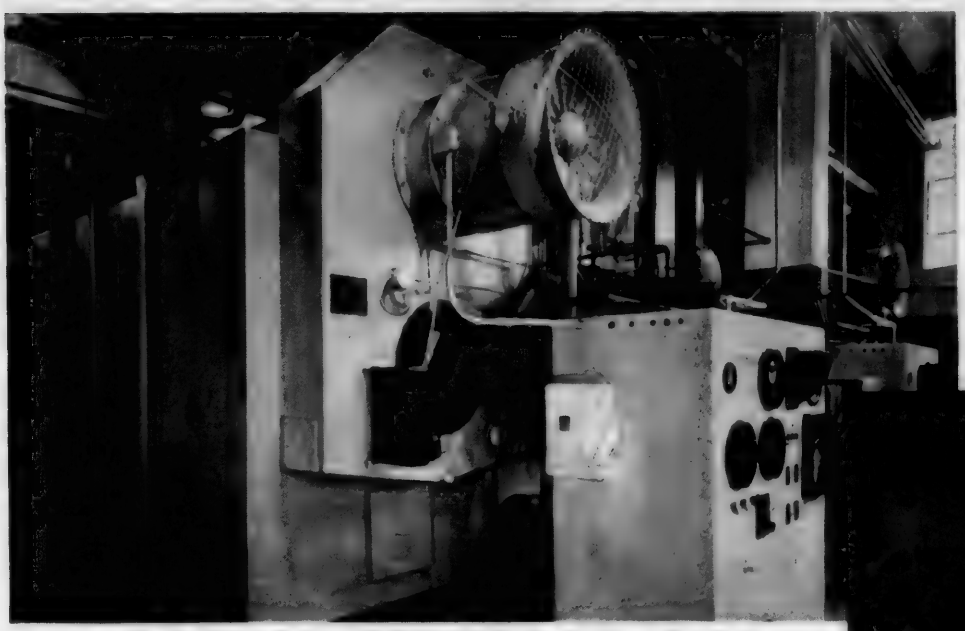
*Wall Exhausters—architecturally sculptured button design spots ventilation control*

**JENN-AIR PRODUCTS COMPANY, INC.**
Architects & Builders Building • Indianapolis 4, Indiana

*keeping steam cheap . . .*

## 2 B&W FM Boilers Provide All Steam For New

# Barberton Citizens Hospital



Consulting Engineers:
*William E. Bodenstein and W. W. Shuster*

Architects:
*Samuel Hannaford & Sons*

Heating, Ventilating, Plumbing:
*T. O. Murphy Company*

Dual unit installation of B&W FM Boilers in Barberton Hospital

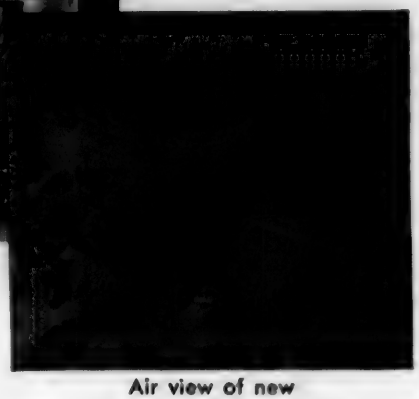
HEATING

HOT WATER

STERILIZERS

KITCHENS

LAUNDRY



Air view of new Barberton Citizens Hospital

The opening of the new 251-bed Barberton Citizens Hospital in Barberton, Ohio, was the proud climax of an intensive ten-year community effort. Incorporating many original ideas as well as design features proved in other modern hospitals, the building and its facilities are as advanced as research and progressive design could make them. Virtually a small city, Citizens Hospital has its own pharmaceutical center, drug store, gift shop, power plant, accounting office, a restaurant capable of serving 37,000 meals a month, and a laundry that can handle 13½ pounds of linen per patient, per day.

Aware of the importance of assuring a reliable and economical steam supply that will fully meet the demanding requirements of hospital service, Barberton Citizens Hospital installed two B&W Integral-Furnace Boilers, Type FM, to meet all steam requirements. The boilers are gas-fired with provision made for using oil as stand-by fuel. The units are automatically controlled to operate under minimum supervision. They have a combined capacity of 41,000 lb of steam per hr, sufficient to supply an additional patient wing if one is built in the future. The present building has a total of 560 rooms for all purposes. The FM Boilers are easily providing all the steam needed for heating, hot water, restaurant, laundry, and sterilizing requirements.

Like this new hospital, many other institutions as well as commercial and industrial users have found the compact, shop-assembled FM Boiler ideal for small to medium steam loads. It is available in standard sizes for loads to 40,000 lb of steam per hr at pressures to 235 psi—may be obtained for higher pressures and with moderate superheat. Get the advantages of this versatile, economical unit if you are planning new construction, modernization, or expansion of your existing steam facilities.

For a detailed, illustrated description of the B&W FM Boiler write for Bulletin G-76A. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

**COST-SAVING FEATURES of the B&W Type FM Boiler**

- Saves Erection Time and Cost
- Meets Wide Range of Service
- Handles Quick Load Changes
- Fast Steaming
- Low Maintenance
- Easy Accessibility
- Suitable for Outdoor Service
- Burns Oil and/or Gas
- Saves Fuel
- Saves Space
- Safe, Automatic Operation

**BABCOCK & WILCOX**

BOILER DIVISION

G-709

G.E. HAS THE ANSWER TO AIR CONDITIONING PROBLEMS IN ANY STORE, OFFICE, OR FACTORY

Acoustical hung ceiling holds supply ducts and registers for distributing air cooled by G-E packaged units. Furred space itself acts as plenum for return air, entirely eliminating need for second set of ducts.

# HUNG CEILING MAKES NEAT AIR CONDITIONING INSTALLATION, SAVES ON DUCTWORK

Fred Safran, well-known New York architect, was faced with the problem of remodelling three floors of a 33-year-old Brooklyn building into an attractive, air-conditioned sales and service center for a large business machine company.

After taking into account the building construction, the heat produced by operating business machines, varying occupancy loads, lighting and ventilating needs, a 15-ton General Electric Packaged Air Conditioner was installed on the first floor, and 10-ton units on each of the two floors above. Conditioned air is distributed through ducts concealed in the hung ceiling, and ceiling diffusers with dampers give precise local zone control. The G-E units take up a minimum of floor space and are completely enclosed, resulting in a neat, built-in installation at a moderate cost.

On the air conditioning phase of this assignment, Mr. Safran worked closely with the Billen Engineering Company, a G-E Air Conditioning Contractor in New York City, to meet the new tenant's specific requirements.

Write for architectural data. General Electric Company, Commercial & Industrial Air Conditioning Department, 5 Lawrence St., Bloomfield, New Jersey.

## HERE'S WHY IT PAYS TO SPECIFY G-E PACKAGED AIR CONDITIONERS

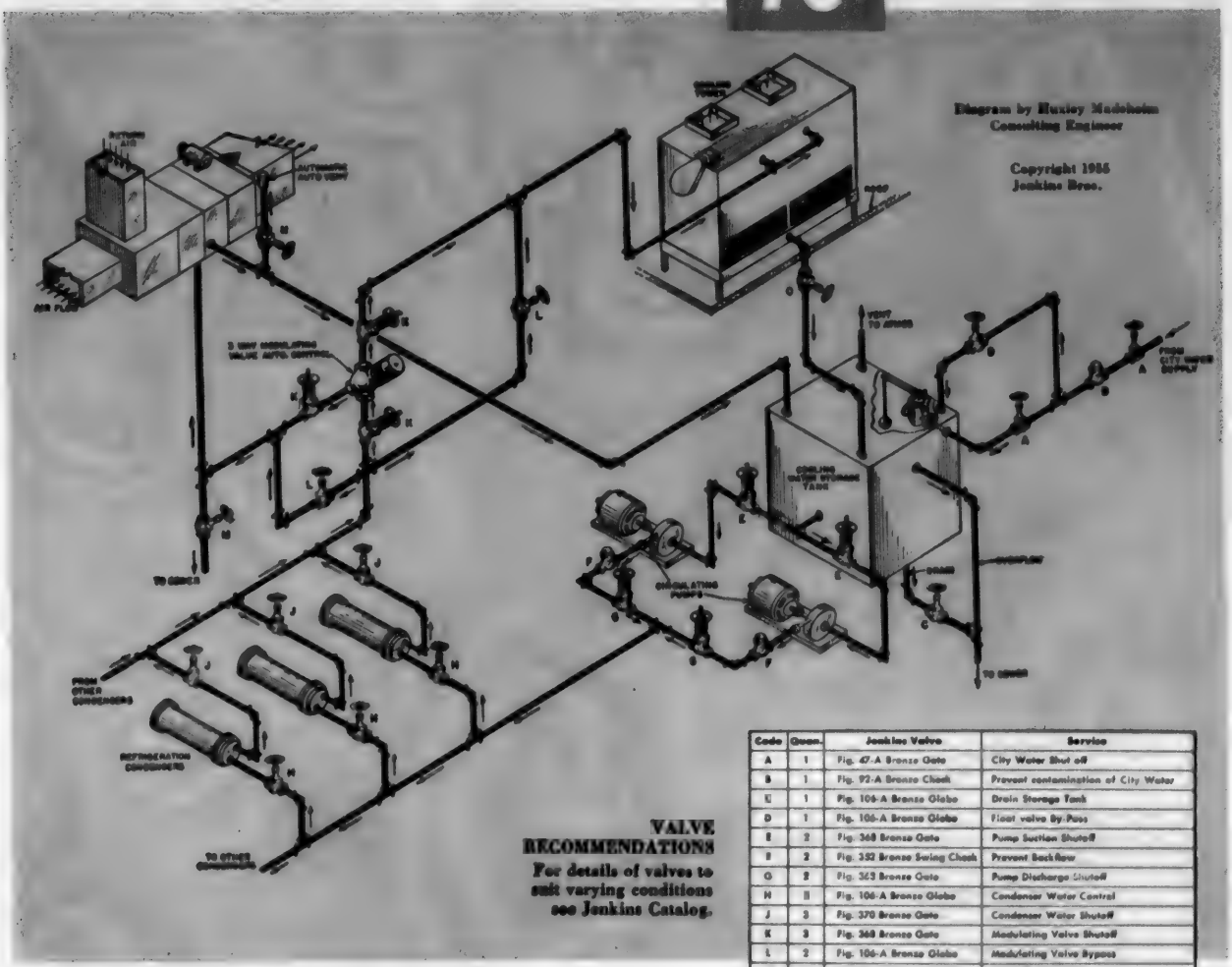
- *Low installation, low operating costs.*
- *Gives the architect maximum design freedom. Units can be used in space or concealed, with or without ducts.*
- *Streamlined cabinet styling. Adds to decor of any interior.*
- *3, 5, 7½, 10, and 15 ton units can be used singly or in multiple to meet air conditioning needs of any building.*
- *Easily directed air flow for no-draft, no-waste air circulation.*
- *Muggy Weather Control removes excess moisture in any weather without over-chilling or clammy cooling.*
- *Built and factory assembled by General Electric. 5-year warranty covers entire sealed cooling system.*

**Packaged AIR CONDITIONERS**

*Progress Is Our Most Important Product*

GENERAL ELECTRIC

# JENKINS PRACTICAL PIPING LAYOUTS 75




| Code | Quan. | Jenkins Valve | Service |
|---|---|---|---|
| A | 1 | Fig. 47-A Bronze Gate | City Water Shut off |
| B | 1 | Fig. 92-A Bronze Check | Prevent contamination of City Water |
| C | 1 | Fig. 106-A Bronze Globe | Drain Storage Tank |
| D | 1 | Fig. 106-A Bronze Globe | Float valve By-Pass |
| E | 2 | Fig. 368 Bronze Gate | Pump Suction Shutoff |
| F | 2 | Fig. 352 Bronze Swing Check | Prevent Backflow |
| G | 2 | Fig. 363 Bronze Gate | Pump Discharge Shutoff |
| H | 11 | Fig. 106-A Bronze Globe | Condenser Water Control |
| J | 3 | Fig. 370 Bronze Gate | Condenser Water Shutoff |
| K | 3 | Fig. 368 Bronze Gate | Modulating Valve Shutoff |
| L | 2 | Fig. 106-A Bronze Globe | Modulating Valve Bypass |
| M | 1 | Fig. 106-A Bronze Globe | Drain Heating Coil |
| N | 1 | Fig. 106-A Bronze Globe | Vent Control |
| W | 1 | Fig. 106-A Bronze Globe | Cooling Tower Water Discharge Shutoff |

## *How to plan piping connections for*

## SPACE HEATING WITH HOT WATER DISCHARGE FROM REFRIGERATION CONDENSERS

**Where continuous refrigeration** is required, the heat absorbed by the water circulating through the condensers during the refrigeration cycle may be transferred to circulating air and used for space heating. This hookup illustrates a system that is widely approved for utilizing waste heat in frozen food plants, ice cream plants, supermarkets, and refrigerated warehouses.

**A cooling tower** for water conservation is included in the usual water cooling system for refrigeration condensers, as indicated. All or a portion of the water which usually flows through the cooling tower system may be diverted and circulated instead through a water coil in the summer air conditioning unit. A three way modulating valve, actuated by a room thermostat, controls the water passing through the two parallel circuits, dividing it according to the heating requirements.

**Excess heat,** when all the heat is not required, is removed by regulating the amount of the water circulated through the parallel path of the cooling tower. Additional heat may be provided, when needed, from any other customary source.

**The cooling tower** circuit provides for water storage in a tank inside the building to avoid freeze-ups. The water circuits shown can be full weight red brass pipe, copper tubing, or black iron pipe.

**This combination** of refrigeration and heating is an adaption of the heat pump cycle and will provide both refrigeration and heat for minimum operating costs.

Consultation with accredited piping engineers and contractors is recommended when planning any major piping installation.

To save time, to simplify planning, to get all the advantages of Jenkins specialized valve engineering experience, select all the valves you need from the complete Jenkins line. It's your best assurance of *lowest cost in the long run.* Jenkins Bros., 100 Park Ave., New York 17.

**COMPLETE DESCRIPTION AND ENLARGED DIAGRAM OF THIS LAYOUT FREE ON REQUEST.** Includes additional detailed information. Ask for Piping Layout No. 75.

JENKINS VALVES

SOLD THROUGH PLUMBING-HEATING AND INDUSTRIAL DISTRIBUTORS

# PIN POINTED FOR SERVICE

Youngstown has 28 district sales offices conveniently located throughout the nation to serve you quickly. They are staffed with men who know the steel business thoroughly and are qualified to help you with your steel requirements. You can get quick service whether you write, wire or phone your nearby Youngstown District Sales Office.

QUALITY Y YOUNGSTOWN SERVICE

## DISTRICT SALES OFFICES

Atlanta 1, Ga.
1310 Healey Building
Phone Walnut 5920

Boston 16, Mass.
250 Stuart Street
Phone Liberty 2-5855

Buffalo 2, N. Y.
1508 Liberty Bank Bldg.
Phone Washington 6270

Chicago 2, Illinois
111 W. Washington Street
Phone Franklin 2-5470

Cincinnati 2, Ohio
1302 Carew Tower
Phone Main 1424

Cleveland 13, Ohio
2400 Terminal Tower Bldg.
Phone Main 1-2605

Columbus 15, Ohio
2850 LeVeque Lincoln Tower
Phone Capitol 4-7211

Dallas 2, Texas
1602 First Nat'l. Bank Bldg.
Phone Riverside 9538

Denver 2, Colorado
814 Continental Oil Bldg.
Phone Main 3-2283

Des Moines 9, Iowa
437 Insurance Exchange Bldg.
Phone 3-1265

Detroit 2, Michigan
926 Fisher Bldg.
Phone Trinity 5-5816

Grand Rapids 2, Michigan
604 Michigan Nat'l. Bank Bldg.
Phone 9-4291

Houston 2, Texas
1350 Esperson Bldg.
Phone Fairfax 1325

Indianapolis 4, Indiana
520 Circle Tower
Phone Melrose 2-3461

Kansas City 6, Mo.
1222 Commerce Bldg.
Phone Victor 5837

Los Angeles 15, Calif.
714 W. Olympic Blvd.
Phone Prospect 7581

Milwaukee 3, Wisc.
2110 Wisconsin Tower
Phone Broadway 1-5148

Minneapolis 2, Minn.
1050 Baker Bldg.
Phone ATlantic 2970

New Orleans 12, La.
520 Whitney Bldg.
Phone Raymond 0153

New York 36, New York
500 Fifth Avenue
Phone Lackawanna 4-4340

Philadelphia 2, Pa.
1502 Girard Trust Bldg.
Phone Rittenhouse 6-9830

Pittsburgh 22, Pa.
Two Gateway Center
Phone Atlantic 1-2350

St. Louis 3, Mo.
611 Shell Bldg.
Phone Geneva 6-1223

San Francisco 5, Calif.
55 New Montgomery Street
Phone Garfield 1-6544

Seattle 4, Washington
457 Central Bldg.
Phone Main 6420

Tulsa 3, Oklahoma
1305 Philtower Bldg.
Phone 54-4634

Washington 5, D.C.
327 Bowen Building
Phone Republic 7-2340

Youngstown 1, Ohio
505 Stambaugh Building
Phone Riverside 7-0771

## THE YOUNGSTOWN SHEET AND TUBE COMPANY

*Manufacturers of Carbon, Alloy and Yoloy Steel*

General Offices: Stambaugh Building - - Youngstown 1, Ohio
Plants: Youngstown, Ohio; Struthers, Ohio; Indiana Harbor, Indiana

SHEETS - STRIP - PLATES - STANDARD PIPE - LINE PIPE - OIL COUNTRY TUBULAR GOODS - CONDUIT AND EMT - MECHANICAL TUBING - COLD FINISHED BARS - HOT ROLLED BARS - BAR SHAPES - WIRE - HOT ROLLED RODS - COKE TIN PLATE - ELECTROLYTIC TIN PLATE - RAILROAD TRACK SPIKES - MINE ROOF BOLTS

## the UNARCO ROYAL-AIRE ...your new "silent salesman"

Efficient in operation and smart in appearance, the all-new UNARCO *ROYAL-AIRE* may be this year's most profitable investment for you.

The *ROYAL-AIRE* is styled to fit into most any background. Four-way directional louvers, generous-sized components, and a large vertical cooling coil provide maximum dehumidification and cooling. *The exclusive* UNARCO *pump-down control system guarantees instant cooling coil response* and reduces system-operating pressures.

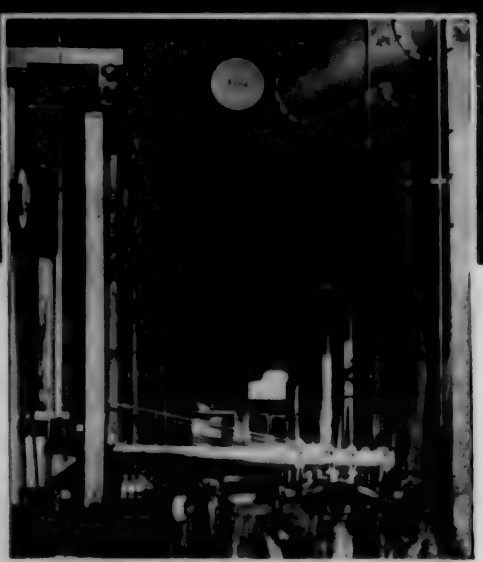
The *ROYAL-AIRE* is available in 5 full-rated models, capable of conditioning exactly to *your* needs. It is especially adaptable to many different and normally difficult kinds of installations. Being "demountable" into three sections, it is extremely easy to handle and install.

Both to the contractor interested in building a reputation for quality, and to the buyer looking for efficient, dependable air conditioning... there is no better buy than the UNARCO *ROYAL-AIRE*.

**UNION ASBESTOS & RUBBER COMPANY**
**332 S. Michigan Avenue • Chicago 4, Illinois**

the UNARCO ROYAL-AIRE ...a quiet, efficient AIR CONDITIONER

*Joy fans are installed in the ducts for greater efficiency, easier installation, and economy of floor space.*



*Vertical branch ducts draw fumes into the trunk line for ultimate discharge into the atmosphere.*

# PLATING LINE VENTED BY JOY AXIVANE® FANS

## Corrosive Air Removed in Jig-time By "In-the-Duct" Installation of Exhaust Fans

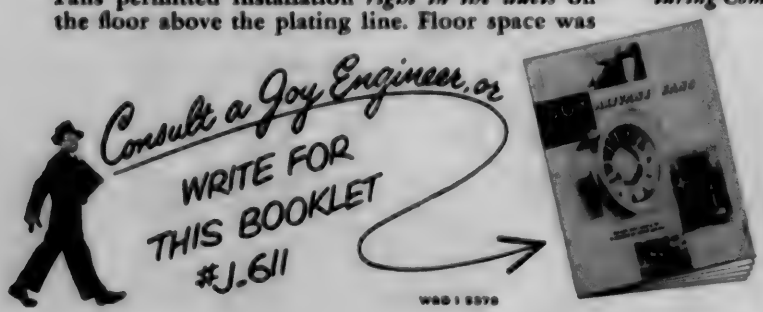
An interesting, and necessary, feature of the new zinc and cadmium plating line at Appleton Electric Company, Chicago, is the compactness of the Joy Axivane Fan exhaust system.

This exhaust system carries off the hot, corrosive air from the plating line up to the roof where it is discharged into the atmosphere.

Centrifugal units would have necessitated an expensive modification in the building structure, in addition to a larger, more complicated duct system.

The compact, in-line design of the Joy Axivane Fans permitted installation *right in the ducts* on the floor above the plating line. Floor space was saved, installation costs were drastically reduced, building structure did not have to be altered, and a much smaller and simpler duct system was constructed!

Joy Axivane Fans will show you new standards in efficiency, compactness, quietness, and outstanding versatility. There are 136 models . . . all with adjustable blades . . . for volumes up to 300,000 CFM and pressures to 11″ wg. Get the full story on Joy Fans by writing for Bulletin J-611, TODAY. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*




JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1905

# 27 YEARS DEPENDABLE OPERATION

## with Detroit Single Retort Stokers in the Cleveland Graphite Bronze Company

(Central Ave. Plant)

These old Detroit Single Retort Stokers have been operating for more than a quarter of a century and are still in excellent condition, giving satisfaction to the owners. Another typical example of Detroit Stoker durability.

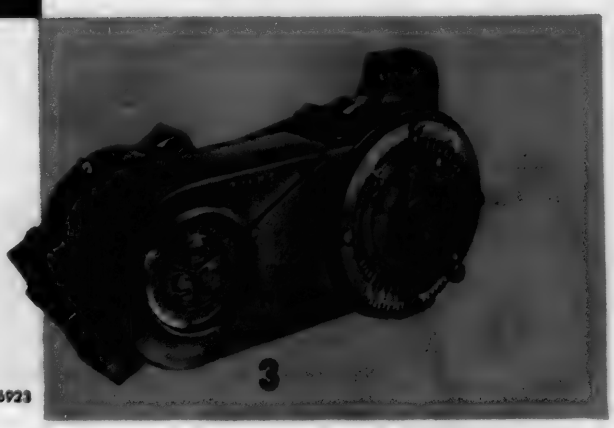
Detroit Stokers are designed and built to outlast the boilers that they serve.

You can buy lower priced stokers but none that cost you less in the long run.

1. Steam engine driven Detroit Single Retort Stokers installed in 1927 at Cleveland Graphite Bronze Company Boiler Plant. Still giving efficient service.

2. Latest type Detroit Single Retort Stokers, individually motor driven, with Detroit Adjustable Feed Controls at Mumford High School, Detroit.

3. Detroit Adjustable Feed (Coal Feed Control) provides many rates of coal feed . . . is regulated either manually or automatically. Air supply from separate fan is properly proportioned to the coal feed for maximum efficiency at all capacities.



## DETROIT STOKER COMPANY

**General Motors Building—Detroit 2, Michigan**

District Offices in Principal Cities • Works at Monroe, Michigan

DETROIT SINCE 1896 STOKERS

6923

# Gallaher Helps Chicago Transit Authority Provide Maximum Safety from Carbon Monoxide

Interior of one of the bus garages of the Chicago Transit Authority. Ventilation is provided by Gallaher power roof exhausters located above the bus bays.

CONVERTING old street car barns into bus garages presented a major ventilation problem to the Chicago Transit Authority. CTA had to find a proven method of ventilation that both would insure positive air removal and would be economical — since CTA is a public authority system.

Fans that handle required volumes of air quietly and efficiently, operated by direct drive motors, were needed. CTA engineers considered numerous bids. Gallaher Air-Vans® - sixty Direct Drive power exhausters — were chosen, the Gallaher bid being the lowest complying with specifications. Since their installation in the three CTA garages on the north and south sides of Chicago, reports of their performance are very favorable.

CTA had to be sure of its ventilation. Gallaher guaranteed positive air removal because of its patented built-in scroll effect design.

The patented design of the air seal-off, low silhouette, low noise levels, availability in special metals and weatherproof design are all developments of Gallaher that have made it a recognized leader in the field of industrial ventilation.

Direct Drive units 150-11,000 CFM. Belt Drive 3500-65,000 CFM, developing static pressure to 4".

***For full information write***

PATENTS 2188741 2326290
PATENTS PENDING

## The GALLAHER Company

***Pioneers in Research-Designed Power Roof Exhausters***

**4108 DODGE STREET** **OMAHA, NEBRASKA**

# BOX SCORE

## ADSCO PISTON-RING EXPANSION JOINT

### PIPING ENGINEERS—Check these points on your score pad!

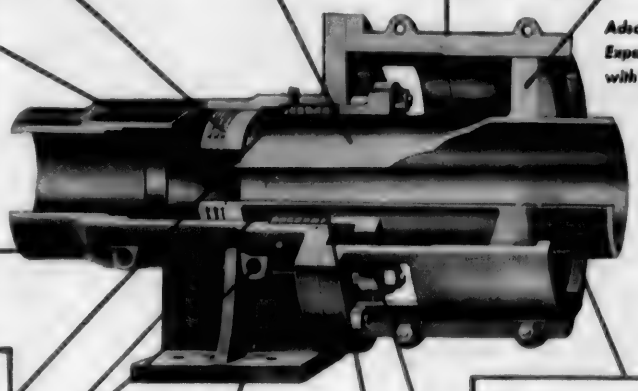
**PISTON RINGS** seated in internal guide ring hold line pressure during unpacking and repacking operation. Internal guide ring is attached to inner end of slip. It moves inside bored cylinder of body, guiding slip accurately. It also acts as limit stop to prevent slip from being pulled out of body. Guide ring and packing prevent polished surface of slip from contacting any metal and thus protect it from becoming scratched or scored.

**EXTERNAL GUIDE** is a bored cylinder, rigidly attached to body, and guides slip flange at outer end of slip. Openings in guide permit easy access to packing gland studs. Guide is built in two halves to reduce size of manholes. Made of semi-steel for operating temperatures to 750 F, annealed cast steel above 750 F.

**SLIP** of chromium-plated seamless steel, with steel flange welded to it, is standard construction for all sizes of both semi-steel and fabricated steel joints. VanStone slips of cast bronze or chromium-plated seamless steel can be furnished at additional cost.

**SLIP FLANGE** of flanged-end joint has outside diameter greater than that of pipe flange to which it is to be bolted. Sliding surface of slip flange is machined to insure accurate guiding.

**BODY** is cast semi-steel in the 125 lb. and 250 lb. series; fabricated steel in the 150 lb., 300 lb. and 400 lb. series. Bodies are stress relieved for operating temperatures over 650 F. Cast steel bodies are furnished on special order only. Machined cylinders of body and external guide provide rigid, axial guiding of slip.



*Adsco Piston-Ring Expansion Joint with Welding Ends.*

**DRIP CONNECTION** is drilled and tapped when so specified.

**LUBRICATION FITTINGS** will be furnished, if so ordered. Otherwise, holes for lubrication fittings are tapped and plugged.

**BASE,** to support joint or serve as intermediate anchor, is drilled with 4 bolt holes. Anchor base for end anchor can be furnished.

**LIP** on external guide acts as secondary limit stop to prevent slip from being pulled out of body. Relief in lip prevents accumulation of foreign particles.

**RELIEF CHAMBER AND VENT** opening exhaust the steam which passes piston rings during unpacking and repacking operation, thereby relieving stuffing box area from all pressure and causing piston rings to seal. A nipple and valve should be connected to vent opening so that steam pressure on the packing is relieved before gland is loosened.

**STUFFING BOX** is proportioned in depth and diameter to provide proper packing space for resiliency of packing and tightness of joint.

**GLAND** is semi-steel for operating temperatures to 750 F, annealed cast steel above 750 F. Studs are carbon steel with cadmium-plated nuts for temperatures to 750 F. Both studs and nuts are alloy steel for use above 750 F.

*Write for Bulletin 35-51*

AMERICAN DISTRICT STEAM DIVISION

**ADSCO INDUSTRIES, INC.**

NORTH TONAWANDA, NEW YORK

PLANTS: BUFFALO, N. Y.—NORTH TONAWANDA, N. Y.—RICHMOND, CALIF.

# Name your heating job... Chances are there's a smartly-styled Modine Cabinet Unit to do it better ...at less cost

For new construction or remodeling, Modine Cabinet Units give you quick, positive and quiet distribution of heated air. With modest-priced accessories, they also provide introduction, filtering and distribution of outside air. Yes, here's the most practical way to heat or ventilate large public rooms or entryways. Some units heat with hot water, cool with chilled water. Others for steam or hot water heating only.

Choose from five models—120 to 640 Edr. Get all the facts and you'll never install unsightly radiators again. See the Modine representative listed in your classified phone book or write for Bulletin 552—Modine Mfg. Co., 1511 DeKoven Ave., Racine, Wisconsin.

**ABOUT THE PHOTOS** **1.** Type BT unit with plenum base installed in school entryway. Duct work concealed in wall discharges heated air through wall grill. **2.** Type BF unit with plenum base recessed in masonry wall of supermarket. **3.** Type BT unit, ceiling-mounted in lumber company office and display room. **4.** Type BF unit with plenum base installed in church.

**Modine**
**CABINET UNITS**

C-1261

# Don't Just Say "COPPER TUBE"...

## Ask for the BRAND that assures TOP QUALITY!

**Sold Through Wholesalers Only**

It's logical to expect superior quality when you ask for *Reading* Copper Tube—you're asking for tubing made by the *"specialists"* of the industry! By making tubing, and only tubing, in one of America's largest, most modern, completely integrated mills, Reading's production experts are able to direct *all* their know-how toward the creation of a better product.

Even Reading's "shirt sleeve" service sets a new standard of quality. Everyone, from our "top brass" on down, stands ready to help you do a better job and build a better business.

*Ask for QUALITY next time you order copper tubing ...ask for READING!*

**READING TUBE CORPORATION**

EMPIRE STATE BUILDING NEW YORK 1 N. Y. PLANT Reading Pa.

Distribution Depots: READING, PA. · WOODSIDE 77, N.Y. 57-17 Northern Blvd. · ATLANTA, GA. 690 Murphy Ave. S.W. Unit 1 Bldg B · HOUSTON, TEXAS 3121 Roosevelt St. · DENVER, COLO. 2845 Walnut St. · CLEVELAND, OHIO 4611 Payne Ave. · CHICAGO, ILL. 724 W. 50th St. · LOS ANGELES, CALIF. 1211 No. Spring St. · OAKLAND, CALIF. 310 Hegenberger Rd.

Shown here are air ducts, 58" x 66" and 38" x 38", of the Atlantic City Convention Hall, which are insulated with aluminum-foil-faced Super·Fine. This job was handled by the Triangle Insulation Company, Inc., of Philadelphia, Pa.

# L·O·F Glass Fibers Super·Fine can reduce installation costs 30%

When you're after an air-conditioning contract, a big saving in insulation cost can be mighty important.

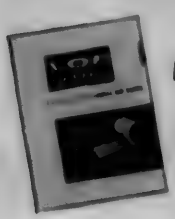
Provided, of course, your insulation material is as good or better than that offered by competition.

**Here's a case in point:** The Triangle Insulation Co., Inc., installed the insulation on the new air-conditioning system at the Atlantic City Convention Hall. The job involved approximately 16,000 square feet of duct insulation.

The specifying engineer realized that L·O·F foil-faced Super·Fine offered high efficiency in insulation material together with a vapor barrier. *Most important, ¾-pound density Super·Fine could be installed at a 30% saving compared to other methods and materials.*

**Here's why installation costs less:**—Super·Fine is pliable and will conform to irregular contours. Easy to handle and apply, there's no shaping or fitting with Super·Fine.

Super·Fine's fine glass fibers will not burn or absorb moisture, will not rot or mildew. It is verminproof and rodentproof.



**FREE!** For helpful folder giving instruction in installation, write: L-O-F Glass Fibers Company, Dept. 63-65, 1810 Madison Avenue, Toledo 1, O.

L·O·F GLASS FIBERS

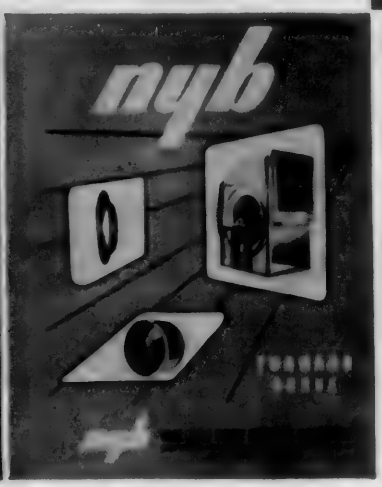
**L·O·F GLASS FIBERS COMPANY**

Makers of glass fibers by the exclusive "Electronic-Extrusion" process

No. 543, Standard Duty Fans
Class I and Class II
No. 544, Heavy Duty Industrial Fans
Class II and Class III
No. 545, General Purpose Fans
Portable Self-Contained Units
No. 546, Forward Curve Fans
Class I and Class II

# nyb new BULLETINS

**Now available**
**write for your copies today.**




A complete new series of centrifugal fans both forward curve and non-overloading (IPL), offering the latest in improved design, sturdy construction and quieter operation are now available.

Bulletins describing these fans with complete engineering data and capacity tables are now ready for distribution.

**nyb THE NEW YORK BLOWER COMPANY**
SALES OFFICES • 3165 SOUTH SHIELDS AVENUE • CHICAGO 16
FACTORY, LAPORTE, INDIANA

*Frick Unit Conditioners are built in 3, 5 and 7½ horsepower sizes. The largest is illustrated. Finish is a beautiful Hammermatic mottled blue-grey.*

TRADE FRICK MARK

# Unit Air Conditioners

**Serve this busy store, as well as restaurants, hotels, offices, factories and many other businesses, everywhere. Note how neatly the conditioner was adapted to the layout of the store through ductwork: this is typical of the complete engineering service you get with Frick equipment.**

**Frick air conditioners have many advantages . . . larger cooling surfaces . . . insulated condensers . . . self-cleaning filters . . .heavier,quieter construction . . . three sizes . . . backed by over 70 years' refrigeration experience.**

**Get full details on other important features from Frick Bulletin 522. Some good territories open for qualified distributors. Write, wire, phone or visit**

DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

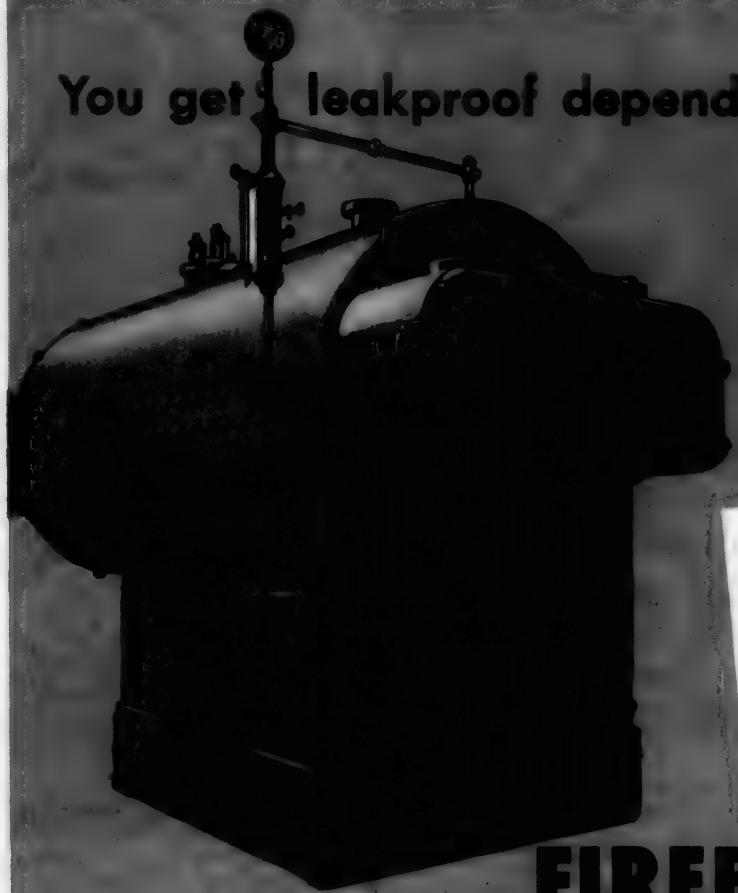
WAYNESBORO, PENNA. U.S.A.

You get leakproof dependable performance with the

# All-Welded All-Around

## TITUSVILLE Type WP

# FIREBOX BOILER



Twelve sizes to cover service requirements from 25 H.P. to 304 H.P.

Yes sir, you can dismiss leak worries with the Titusville WP—this precision-formed, fusion-welded boiler remains tight under all operating conditions, and is the satisfying answer to your demand for high efficiency and low maintenance at sensible cost. Ask for latest Bulletin B-3030.

TITUSVILLE IRON WORKS CO. TITUSVILLE, PA.

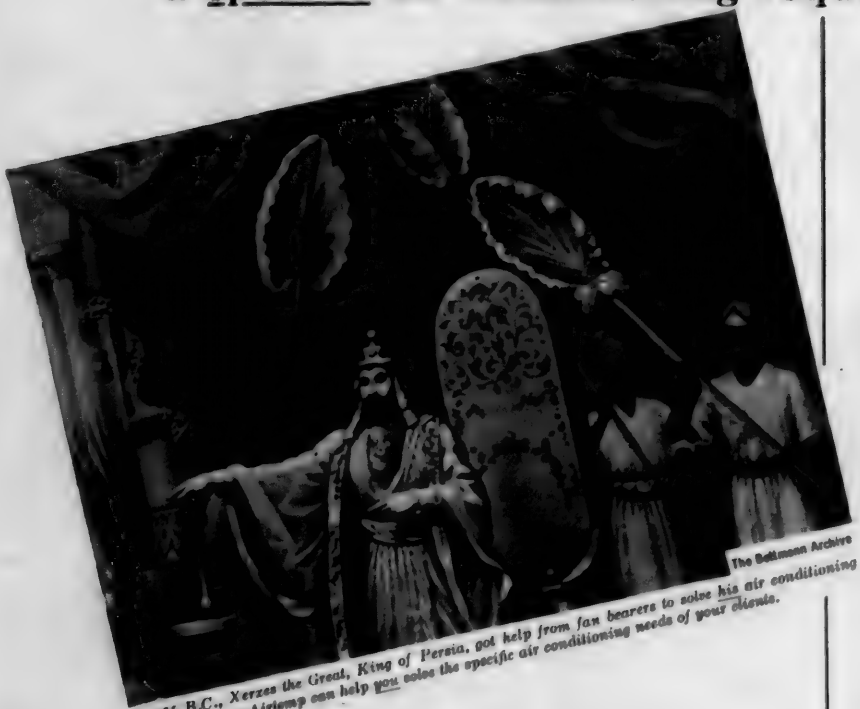
A division of Struthers Wells

**THE TITUSVILLE IRON WORKS COMPANY**

*TITUSVILLE, PENNSYLVANIA*

***Manufacturers of* A Complete Line of Boilers for Every Heating and Power Requirement**

# want help on a specific air conditioning requirement?



The Bettmann Archive

*In 466 B.C., Xerxes the Great, King of Persia, got help from fan bearers to solve his air conditioning problem. Today Airtemp can help you solve the specific air conditioning needs of your clients.*

## AIRTEMP gives you specialized service

**Let Airtemp give you these special helps in planning your commercial and industrial air conditioning**

***The equipment you need***
To meet your clients' needs, Airtemp offers a complete range of modern air conditioning systems. Both conventional and specially-engineered types, for a room or a building.

***Top engineering assistance***
You get help from engineering specialists—pioneers in commercial and industrial air conditioning—through Airtemp Construction Corporation, subsidiary of Chrysler Corporation.

***The trusted Chrysler name***
Your clients have confidence in Chrysler's leadership. And dependable Airtemp service has gained full public acceptance.

***Dependable local service***
Your guarantee of continuing local service is the nationwide network of trained Airtemp personnel and facilities.

***Lower costs per job***
Operating costs are lower, due to the highly efficient Airtemp operation and design.

***For complete information***
on how Airtemp can be of service to you, write to: Airtemp Division, Chrysler Corporation, Dept. ACHV-6-55, Dayton 1, Ohio.

**AIRTEMP MEETS SPECIFIC NEEDS**

**Grace-New Haven Community Hospital,** New Haven, Conn. Architect: Douglas Orr; Engineers: Hubbard, Lawless and Blakely.

**Idaho Terrace Apartment Building,** Washington, D. C. Architect: David Stern; Builder: Stern and Small; Mechanical Contractor: Leroy Mason.

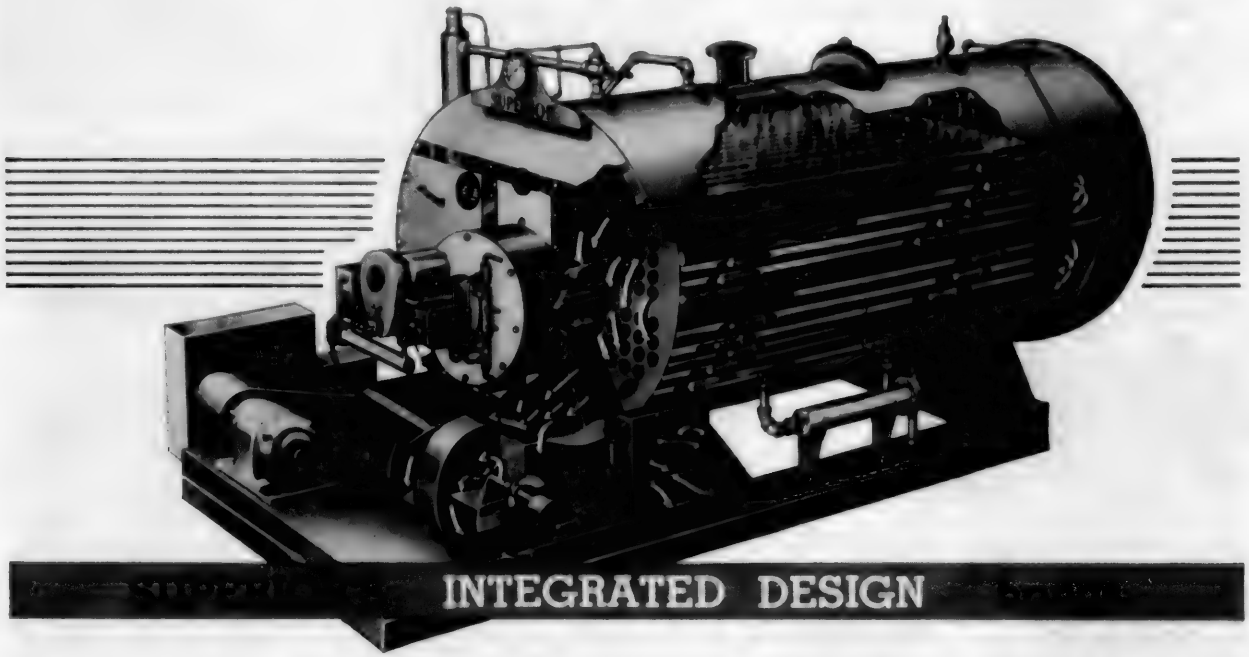
**Baron Hirsch Organization Synagogue,** Memphis, Tenn. Architect: George Awsumb & Son; Engineers: T. J. O,Brien Engineering Co.

AIRTEMP
Comfort Zone

Airtemp
DIVISION OF CHRYSLER

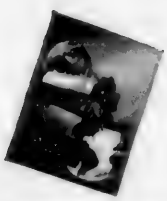
**AIR CONDITIONING • HEATING FOR HOMES, BUSINESS AND INDUSTRY**

# MAXIMUM { HEAT TRANSFER / STEAM RELEASE / LIFE



## INTEGRATED DESIGN

## the THREE KEYS to LOW COST STEAM



*Superior Steam Generators burn oil or gas or both; are available in 18 sizes from 20 to 600 b.h.p. and pressures to 250 p.s.i. or for hot water. Write today for complete details in Catalog 719.*

Integrated design is one of the most important advantages of completely packaged Superior Steam Generators. Components of these units are designed and built to operate efficiently with one another. This careful sizing and matching of burner capacity, heating surface, steam space and evaporating surface, eliminates the danger of waste due to excessive stack temperatures, or wet steam which results from surging and foaming in restricted space on the water side.

Bigger, heavier, more thoroughly engineered Superior Steam Generators provide the most steam per dollar over a longer serviceable life.

*for performance you can* **BANK** *on*

**SUPERIOR STEAM GENERATORS**

**SUPERIOR COMBUSTION INDUSTRIES INC.**
**TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.**

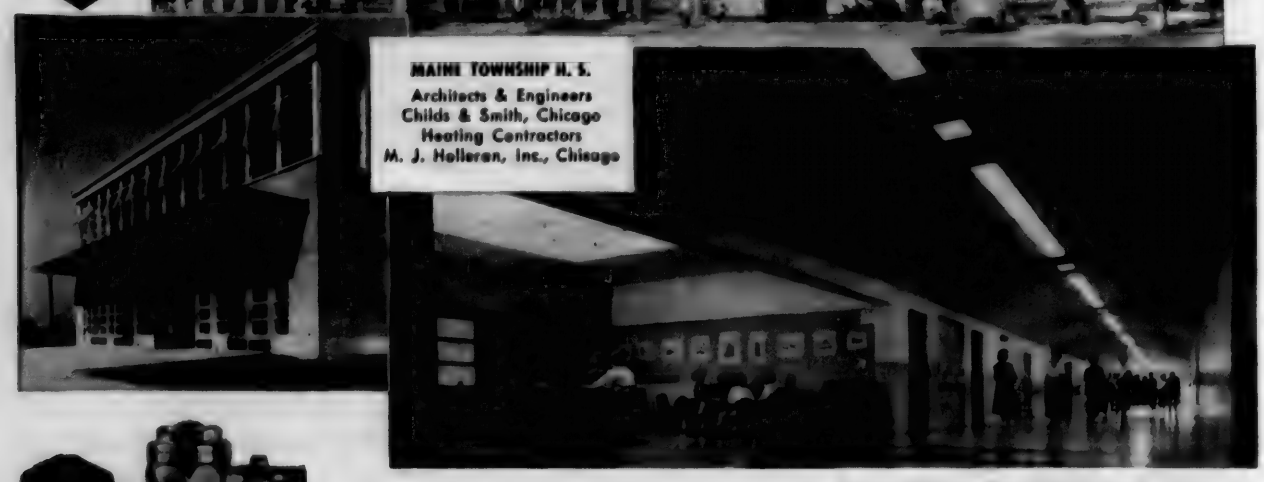
# 5-MILLION DOLLARS IN HIGH SCHOOLS

Gymnasium section, Hinsdale H. S.

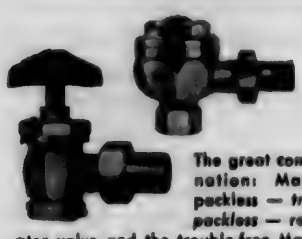
**HINSDALE TOWNSHIP H. S.**
Architects & Engineers
Childs & Smith, Chicago
Heating Contractors
William A. Pope Co., Chicago

Auditorium section, Maine Township H. S.

**MAINE TOWNSHIP H. S.**
Architects & Engineers
Childs & Smith, Chicago
Heating Contractors
M. J. Holleran, Inc., Chicago



Famous 600-ft. corridor, Maine Township H. S.



The great combination: Marsh packless — *truly* packless — radiator valve and the trouble-free Marsh thermostatic trap.

The Marsh float and thermostatic trap. There is a Marsh trap for every heating service.

## *Marsh Valves and Traps all the way through*

The answer of three Chicago suburbs to the bumper crop of teen-agers . . . these two college-size high schools. Among America's largest and finest, they cost 5 millions and contain 337,000 sq. ft. of efficiently utilized floor space.

The fabulous, 3-million dollar expansion of Maine Township High will serve the suburbs of Park Ridge and Desplaines. Hinsdale High, a 2-million dollar high school, is for the young folk of famous Hinsdale alone. Who says we are not catching up with schooling needs? That 600 ft. corridor in the Maine Township school sets a standard of architectural design and quality construction never before found in the nation's schools.

For the best in buildings, the best in heating of course . . . and for the radiators and coils, the best in valves and traps. Hundreds of Marsh Packless Radiator Valves, Radiator Traps and F & T Traps went into the well designed heating systems which involve both direct and indirect radiation.

An excellent example, this — but only one of many examples of the respect for Marsh quality demonstrated on a nation-wide scale in the selection of Marsh equipment by foremost architects and contractors. Ask for Catalog 76-H covering the full line of Marsh Heating Specialties.

**MARSH HEATING EQUIPMENT CO.,** *Sales Affiliate of Jos. P. Marsh Corporation* **Dept. U, Skokie, Illinois**

# MARSH Heating Specialties

**TWENTY-FOOT LENGTHS** of 10" I.D. copper tubes receive final inspection in one of the mills of The American Brass Company. ANACONDA Seamless Drawn Copper Tubes are made up to 26" I.D.

# Anaconda Copper Tubes last longer... can actually lower your plant piping costs

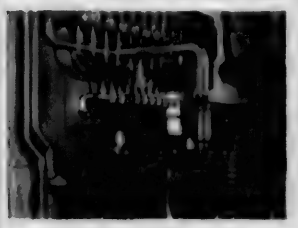
Planning a new installation? Want to replace unsatisfactory piping? Then look into the cost and performance advantages of ANACONDA Copper Tubes *first*. Many plants have found them the *least costly* piping material available.

*Here's why:* ANACONDA Copper Tubes are light. They come in long lengths. Smaller sizes are bent right on the job. All this means big savings on installation costs. And copper tubes can't rust. They resist corrosion and guard against contamination. Smooth interiors mean smoother flow. Pumping costs are often lower.

*Here's another advantage.* ANACONDA Copper Tubes – connected with solder-type fittings – can be taken down, moved or have new connections cut in faster than with threaded pipe. *You can meet changing plant conditions easily.*

If we can be of assistance in solving a piping problem in your plant please write to: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Limited, New Toronto, Ont.*

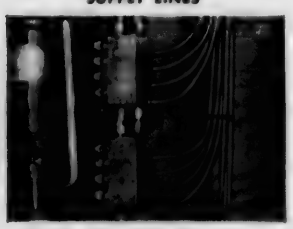
**Use Anaconda Copper Tubes for:**



REFRIGERATION AND AIR CONDITIONING

HOT AND COLD WATER SUPPLY LINES

INDUSTRIAL HEATING LINES



AIR, LUBRICATING AND HYDRAULIC LINES

**for copper piping call an**

**ANACONDA**

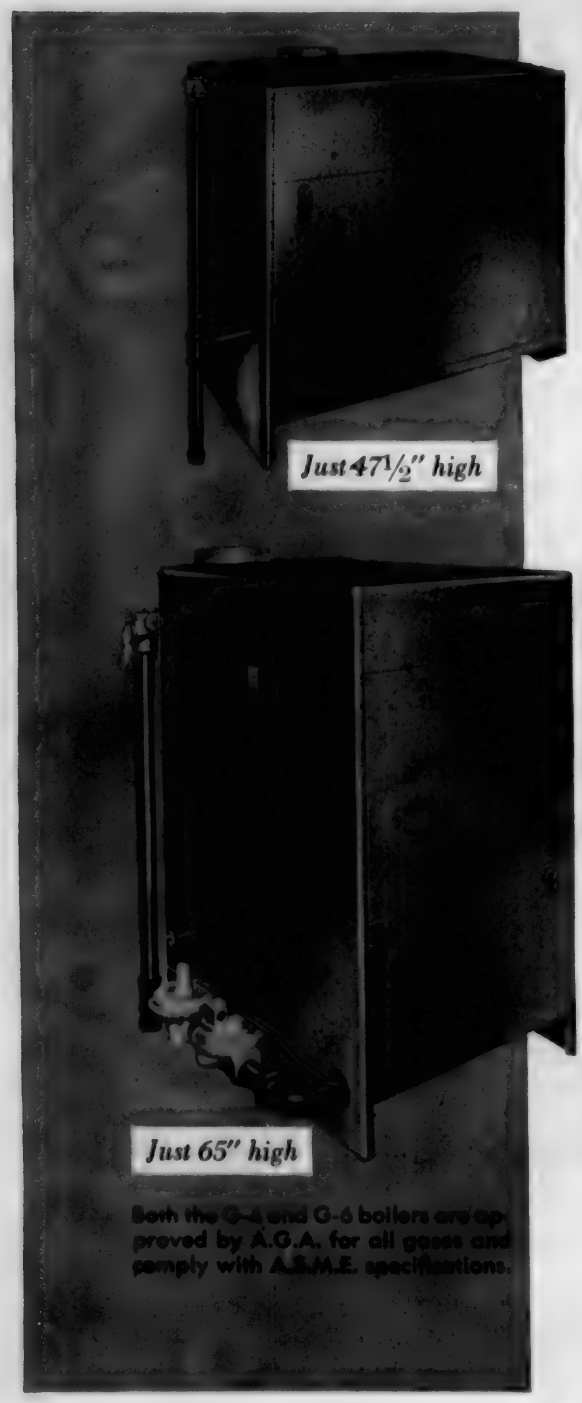
**Distributor**

*so you can sell and install during the summer building season*

# Two New Gas-Fired Boilers

## BY AMERICAN-STANDARD

*They're Neater, Better Looking!* • *They're Lower, More Compact!* • *They're Expandable, More Versatile!* • *They're Easier to Install and Service!*


Just 47½" high
Just 65" high
Both the G-4 and G-6 boilers are approved by A.G.A. for all gases and comply with A.S.M.E. specifications.

MODERN in design throughout with attractive 20-gauge steel jackets, these brand-new, space-saving boilers with built-in drafthoods, are ideal for large homes, apartments, schools, office buildings and commercial buildings. They also incorporate many engineering and construction features which make for higher operating efficiency . . . as well as installation and servicing economies. Some of these advantages are listed below.

**G-4** ● For water or steam . . . available from 4 to 11 sections with inputs from 180,000 to 600,000 Btu per hour.

● Design based on use of multiple sections with burner for each flue passage. Factory tested burner has an input of 60,000 Btu per hour.

● Sections easily assembled . . . end sections designed with extended base to form supporting legs. Jacket encloses canopy, manifold and controls. Can be assembled after heating piping is in place.

● Pintype boiler sections—over 600 pins on each center section. Easily removed cleanout panel allows access to boiler sections without removing jacket.

**G-6** ● For water or steam. Available from 6 to 41 sections with inputs from 650,000 to 5,200,000 Btu per hour.

● Pintype projections—over 1200 on each center and intermediate section give heating area usually found only in much larger flat-surfaced sections. Multiple section design permits almost exact sizing of boilers to meet widest range of installations.

● Various tapping arrangements allow maximum flexibility in system piping. Smart looking jacket may be assembled after heating piping is installed. Removable access panels make boiler easy to service.

● Cast-iron base firmly supports boiler sections and burners. Facilitates installation.

● Manifold is factory assembled and rigidly fastened to base by cast-iron clamps.

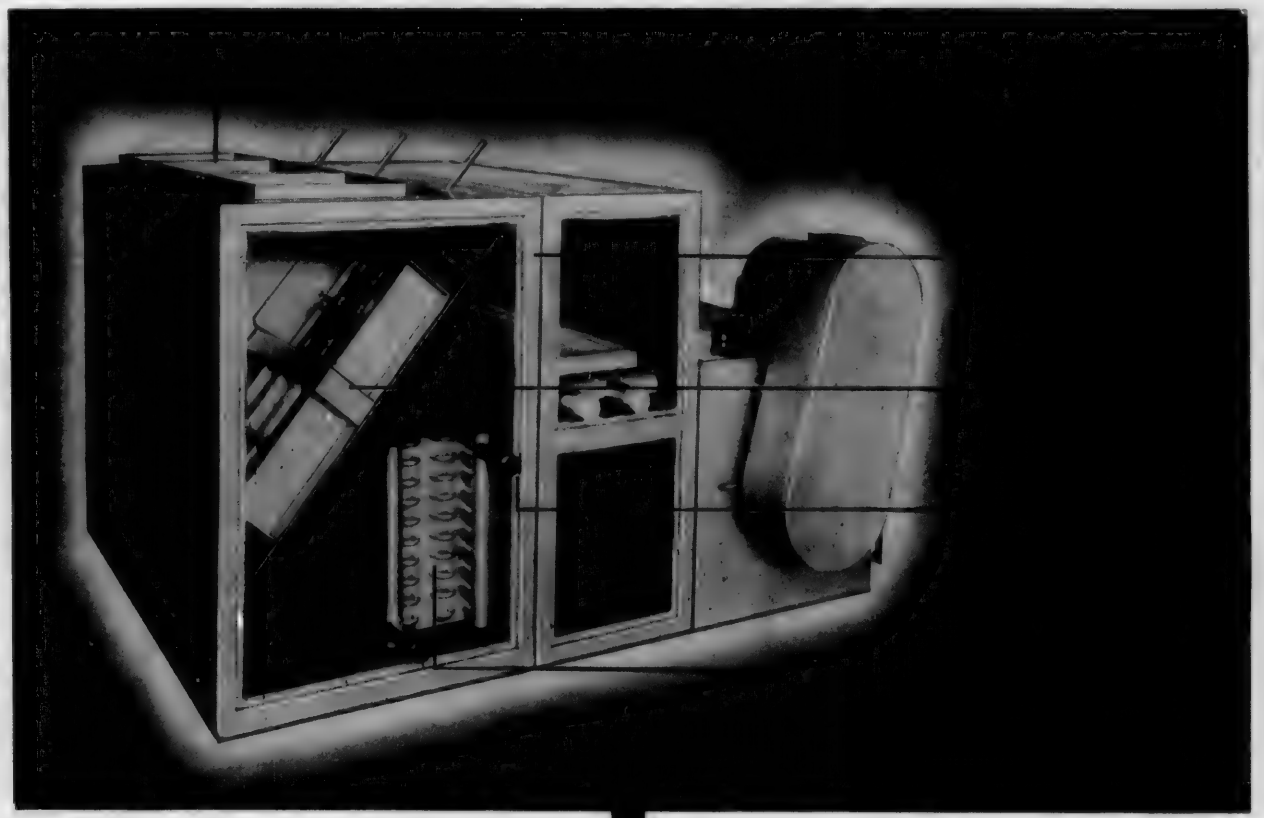
For a more detailed description of these boilers, just contact your distributor or the nearest American-Standard Sales Office. Plumbing and Heating Division of American Radiator & Standard Sanitary Corporation, P. O. Box 1226, Pittsburgh 30, Pa.

**AMERICAN-STANDARD**

**HOT WATER HEAT**

*Serving home and industry:*

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE
DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS



## ANOTHER NEW PRODUCT IN THE EXPANDING BUSH LINE

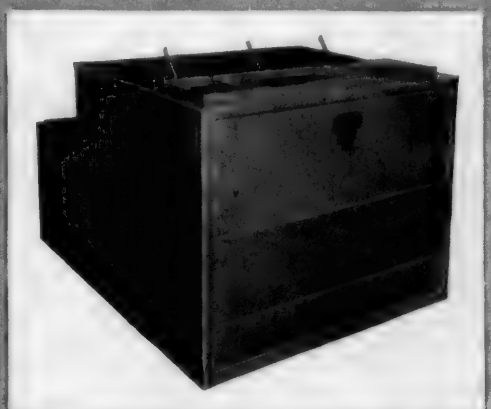
# BUSH MZ MULTIZONE AIR CONDITIONING UNITS

**A single unit replaces several Bush 'MZ' Multizone Units provide simultaneous air conditioning of separate rooms or zones at any desired temperature . . . make possible *individualized* conditioning of such areas.**

**Steady temperature control possible with Bush 'MZ' Units is especially advantageous where the problem of fluctuating cooling and heating loads exists . . . where sun load and occupancy vary.**

**Contractors, architects and consulting engineers welcome the clean-lined compactness of these units . . . the sectionalized construction which permits easy handling and installation.**

**Capacities range from 2,560 to 24,000 C.F.M.**

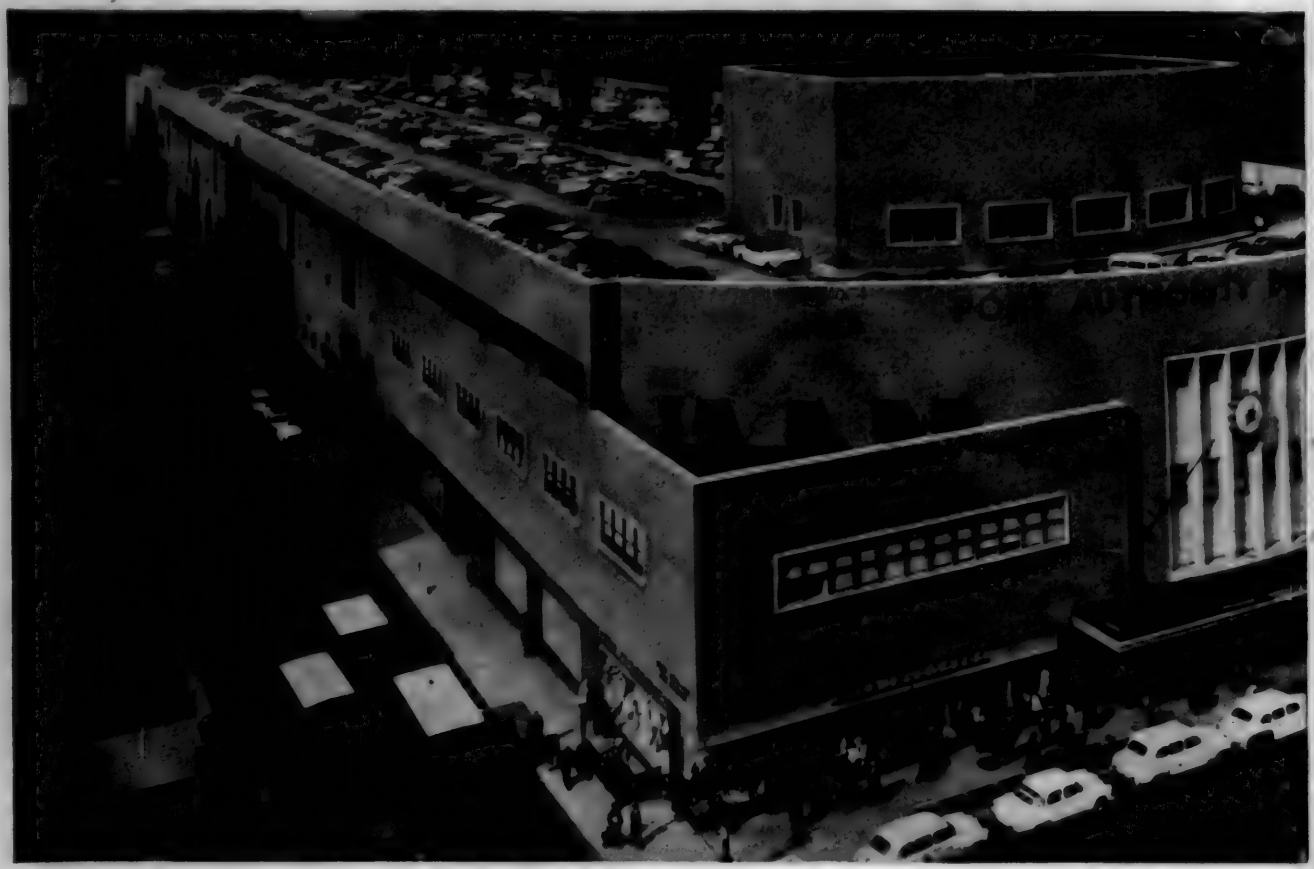


BUSH

*Request Bulletin #505 containing complete information.*

**BUSH MANUFACTURING COMPANY · West Hartford · 10 · Conn.**

RIVERSIDE · CALIFORNIA



Located in Manhattan, the Port Authority Bus Terminal handles over 2,500 buses daily. Loading and unloading stations are on two levels: one in the basement, one on the third floor. American Blower equipment provides fresh atmosphere throughout the terminal's 11,376,000 cu. ft. of space, including its nearly 90 business locations.

# World's largest bus terminal doubles as

Each store proprietor chooses the perfect climate for his business . . . thanks to 90 individual American Blower Air Conditioners. The adaptability of the units allowed horizontal or vertical installation, saved space. In the smaller shops, units are ceiling-suspended and fully enclosed; others are floor-mounted.

To air-condition terminal's bowling alley, American Blower Unit was installed in vertical position. Glenn Gessler, maintenance supervisor, says — "I like American Blower equipment. Periodic cleaning of coils has been the only maintenance required in over four years of operation!"

Two American Blower Ventilating Fans, housed in the tower atop the Port Authority Terminal, exhaust fumes and gases from the basement bus-loading level at up to 150,000 cfm. Giant-sized (about 18 ft. in diameter), they provide a change of air every nine minutes.

# complete air-conditioned shopping center

**In addition to ventilating huge interior roadways, the Port of New York Authority Bus Terminal uses American Blower equipment to individually air-condition its nearly 90 stores**

The Port of New York Authority Bus Terminal is more than the world's largest bus terminal, serving 130,000 commuters a day . . . it's also a complete shopping center with nearly 90 business establishments. Here, you can board a bus, go bowling, or buy almost anything—from a quick snack to a short shave—in ocean-fresh atmosphere supplied by American Blower equipment.

There are two bus-loading levels. One is below ground, where large American Blower Ventilating Fans change the air every nine minutes. The other is on the third floor. During rush periods, as many as 750 buses an hour load and unload. But fumes are no problem.

Each of the business locations, however, has its own climate requirements. The candy store, for instance, needs cool temperatures to keep chocolates firm; the pet shop, with its snakes and tropical fish, requires warmer temperatures. Ninety American Blower Air Conditioners—which individually cool, heat, filter, and dehumidify—enable each proprietor to select the exact climate he wants . . . without recirculating the odors of the other stores.

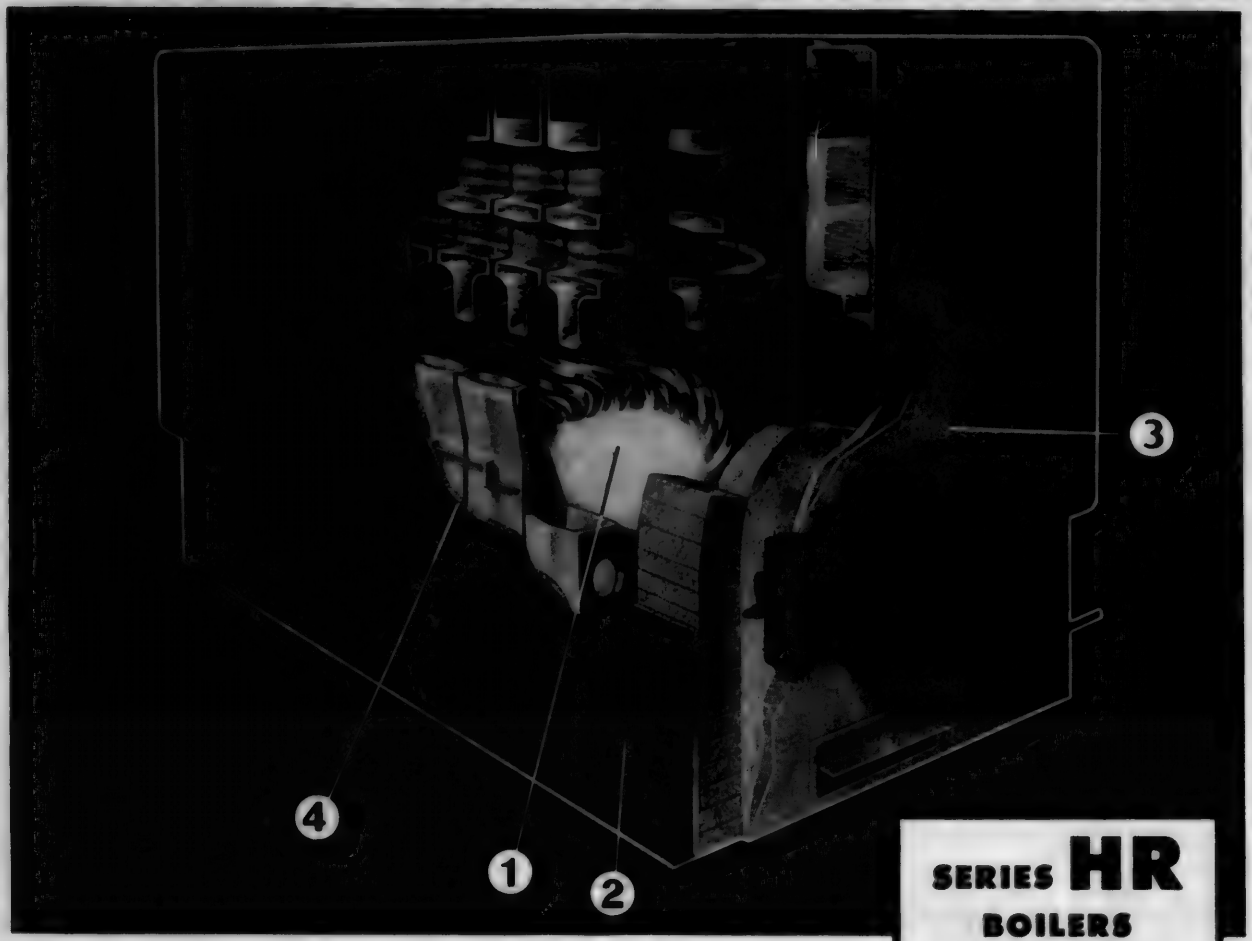
Every day, more and more people benefit from the efficiencies and economies of American Blower equipment and service. How about *you*? Whether your air-conditioning or ventilating needs are large or small, contact your American Blower Branch Office for friendly, expert assistance. In Canada: Canadian Sirocco Co., Ltd.

**AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN**
**CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO**
Division of American Radiator & Standard Sanitary Corporation

**AMERICAN BLOWER**

*Serving home and industry:* AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • TRUANE AIR CONDITIONERS

# THE FIRST *CAST IRON* BOILER DESIGNED SPECIFICALLY FOR HORIZONTAL ROTARY OIL BURNERS!




## WEIL-McLAIN

**PRESENTS A HEAVY DUTY BOILER DESIGNED IN COOPERATION WITH LEADING MAKERS OF ROTARY OIL BURNERS**

In the "HR Series," Weil-McLain makes a revolutionary advance in boiler design...an ASME constructed *cast iron* unit engineered to provide the best operating conditions for horizontal rotary oil burners!

The cut-away above illustrates the major features which make the "HR" completely outstanding in performance when fired with burners using heavy oil.

Note also the other Weil-McLain features which contribute to exceptionally high overall efficiency. The curved primary heating surface increases the area directly over the fire...large waterways assure rapid circulation...back and forth, balanced flue gas travel distributes heat equally to all secondary heating surfaces...sectional construction with short draw-rods simplifies erection.

***Get the facts—write today for complete engineering data.***

**SERIES HR BOILERS FOR BURNERS USING HEAVY OILS**

●

***FEATURES!***

1. **Large fire box volume develops better combustion conditions and maximum radiant heat transfer.**
2. **High base makes more combustion space available—eliminates high brick foundation.**
3. **Special steel front plate simplifies installation of rotary burners. Openings can be cut at factory for specific makes.**
4. **Green enameled steel jacket lined with thick blanket of fibre glass—saves insulating time.**

WEIL-McLAIN BOILERS · RADIATORS

**WEIL-McLAIN COMPANY**
MICHIGAN CITY, INDIANA

**Address literature requests to Dept. BB-65.**

# Skidmore Pumps
## a type for every need
## — CHOOSE WITH CONFIDENCE

TYPE "UV"—Duplex Unit Recommended for below floor level returns. The duplex pump consists of one cast iron receiver — two pumps, two motors and complete float mechanisms. Each pump of the duplex unit is mounted on its own plate . . . either pump may be removed for inspection without disturbing the second unit.

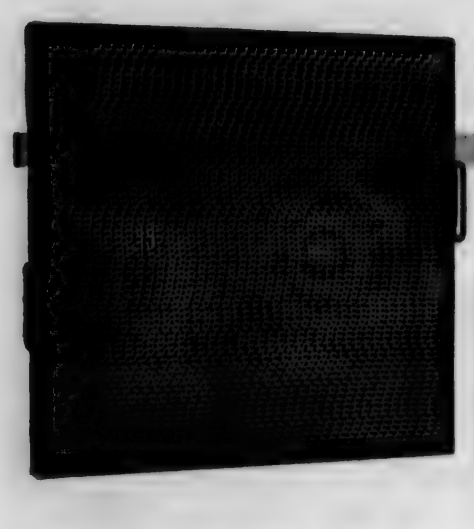
**Write for Bulletin No. 19-A**

Contains complete data on both the single and duplex units. Bulletins on other pumps sent on request.

SKIDMORE PUMPS

**SKIDMORE CORPORATION • ST. JOSEPH, MICHIGAN**

# You're really looking at 9 air filters!



Type 68—2"—finer mesh media and tighter pack for higher efficiency on small particles.

Type 44-68—4"—double packed for special applications requiring the highest efficiency.

Type 44—1"—gable crimped for high efficiency; for ventilation, package air conditioners, furnaces, etc.

Type 44—2"—general ventilation for dirt, lint, paint, grease, oil, etc.

Type 44—4"—for greater dirt capacity.

Type MZ—2"—zinc chromate painted before and after assembly; hot dipped galvanized frame; marine ventilation application.

Type MZ—4"—same except 4" thick.

Except as noted, filters are made of zinc electroplated herringbone-crimp steel screen media in sturdy steel frames. Other materials are aluminum, stainless steel and monel. Available in all sizes.

Type C4C4—2"—all copper media and frame; for corrosion resistant water eliminators, etc.

Type C4C4—4"—same except 4" thick.

Because one filter won't do *every* air cleaning job, Farr Company has nine standard types designed to handle practically any dirt condition. Each embodies the famous herringbone-crimp media design and other Far-Air quality features, but differs in materials, thickness, etc. When you select the type you need from the Far-Air line, you are assured of getting the most practical solution for your particular dust problem. Remember, the operating efficiency of the entire air handling system is dependent on the filters used. That is why it is important that the *right type* filters be installed. Farr field engineers will be happy to study your air cleaning problems and make specific recommendations.

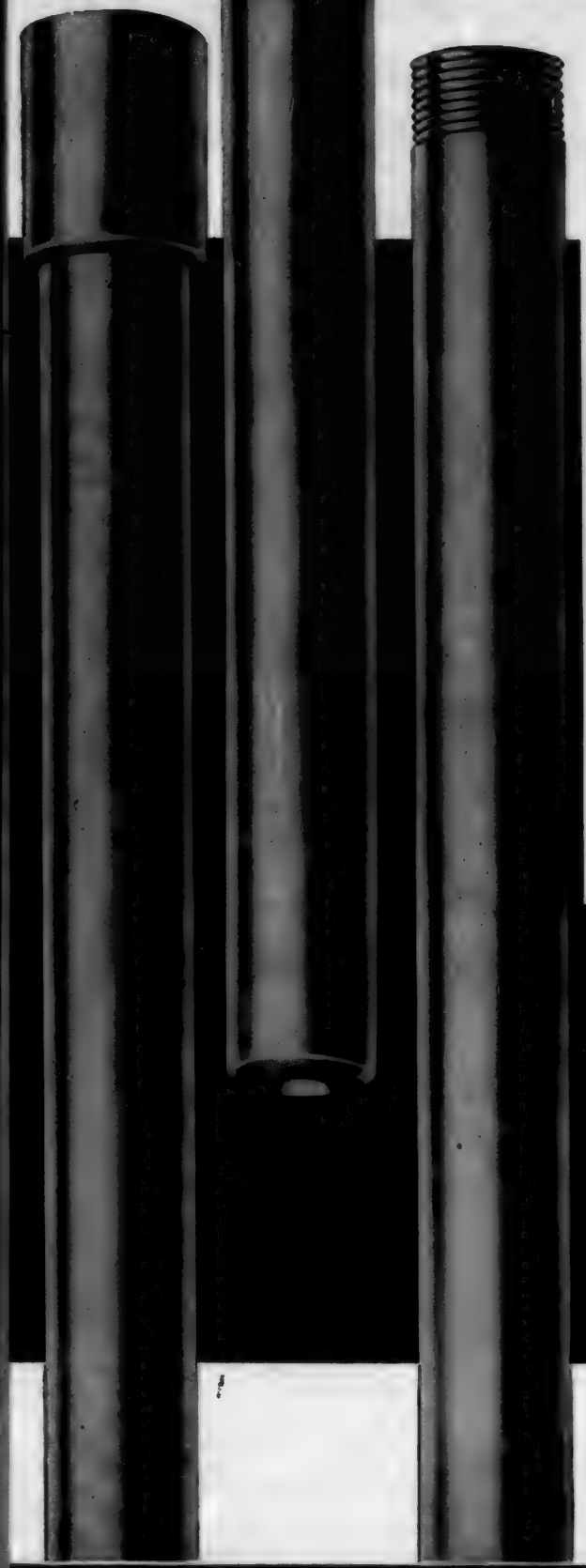
*Send for complete catalog of FAR-AIR products to Farr Company, P.O. Box 43187, Airport Station, Los Angeles 45, California*

FARR COMPANY

NO COMPROMISE ON QUALITY

*Los Angeles, New York, Chicago, Memphis*

# NATIONAL *Continuous Weld* LINE PIPE



## for air, oil, gas and water line applications

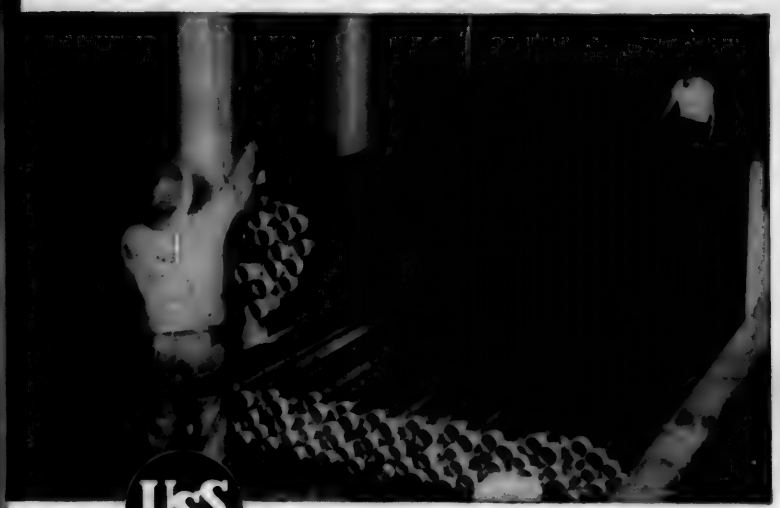
The superiority of NATIONAL Continuous-Weld Line Pipe pays off for you in easier installation, better performance and longer service life. This superiority is based on three important factors. First . . . Over 60 years of experience in making tubular products famous for their high quality. Second, the most modern butt-weld pipe-making facilities in the world at Fairless Works, Fairless, Pa. And, third, the use of the unique stretch-reduction process, employed by National Tube since 1942.

Combined they give you a butt-welded line pipe that is always completely uniform throughout—in metallic structure, ductility, strength, corrosion resistance, surface finish and wall thickness. The working of the metal in the exclusive stretch-reduction process, itself, gives NATIONAL Continuous-Weld Line Pipe a better weld and a higher safety factor.

Get NATIONAL Continuous-Weld Line Pipe. It is available in sizes ½-inch to 4 inches. It's your best buy for air, oil, gas and water line installation.

For further information, write National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

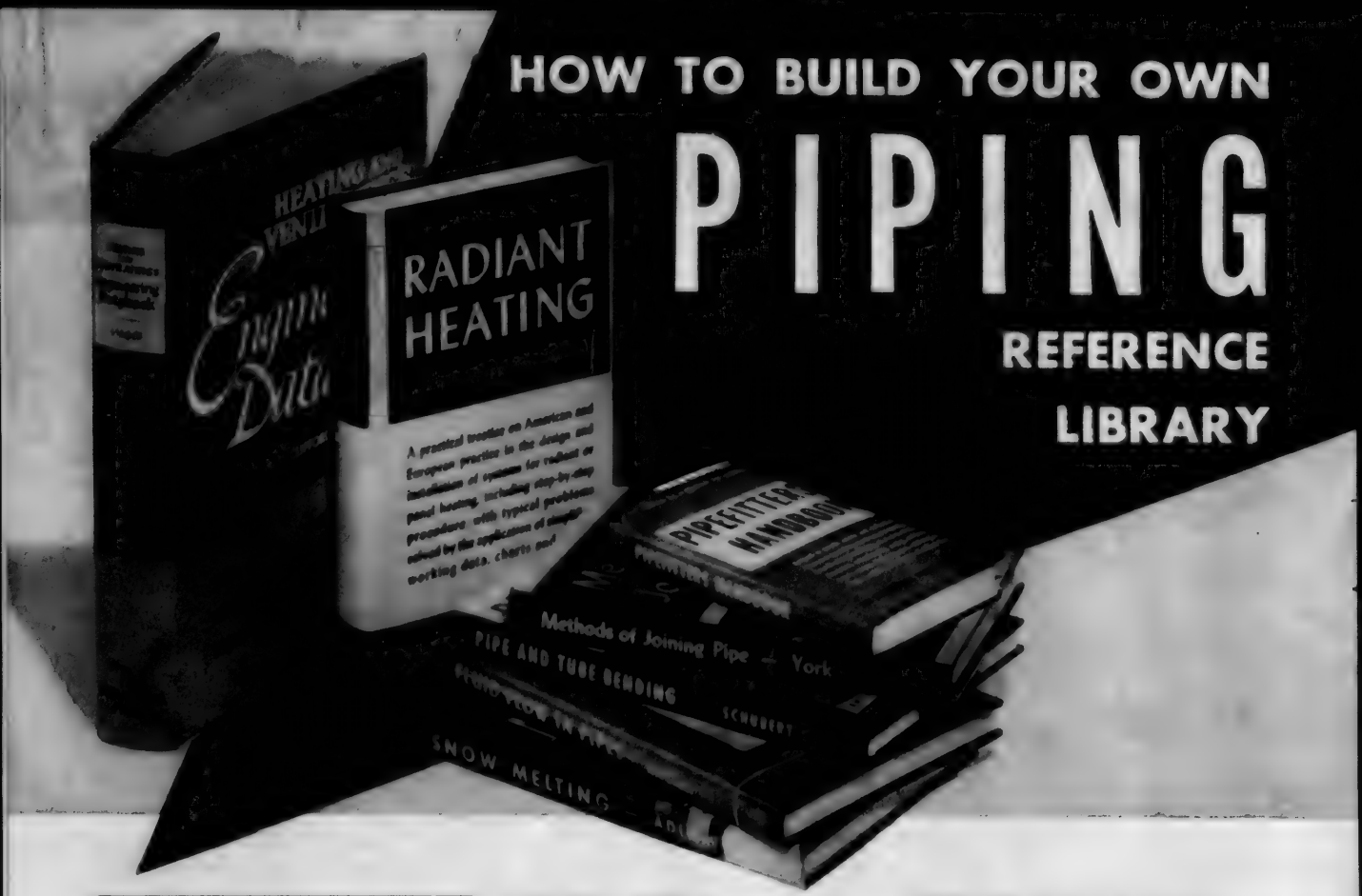


USS

NATIONAL *Continuous Weld* LINE PIPE

UNITED STATES STEEL

# HOW TO BUILD YOUR OWN PIPING REFERENCE LIBRARY


RADIANT HEATING
A practical treatise on American and European practice in the design and installation of systems for radiant or panel heating, including step-by-step procedures with typical problems solved by the application of simple working data, charts and
PIPEFITTERS HANDBOOK
Methods of Joining Pipe
York
PIPE AND TUBE BENDING
SCHUBERT
SNOW MELTING

**With these books, written by outstanding authorities, you can build a piping reference library that will give you a sound background of principles, as well as a source of practical reference that will help you solve your problems of design and installation. Order the books you need today . . . and note details of our Five-Day Free Inspection Plan in the coupon below.**

**HEATING and VENTILATING's ENGINEERING DATABOOK— by Clifford Strock**

Essential working data and practical information on piping, heating, air conditioning, ventilation, air sanitation and refrigeration. Time-saving tables and large scale charts simplify estimating and design problems.

**578 pages, 8½" x 11", $7.00**
In Canada or overseas, $8.15

**RADIANT HEATING— by T. Napier Adlam**

The basic principles, the experience-proved facts, the practical working data on applications of radiant energy that can be applied directly in designing and installing radiant heating systems.

**504 pages, 337 illustrations, $6.00**
In Canada or overseas, $6.91

**PIPEFITTERS HANDBOOK— by Forrest R. Lindsey**

Enables pipefitters to solve problems of pipe bending, mitering, layout, threading, etc., either in the shop or in the field. Convenient pocket size, flexible Fabrikoid binding.

**282 pages, $6.00**
In Canada or overseas, $6.65

**METHODS OF JOINING PIPE— by J. E. York**

Detailed information on standard and special joints for all types of metallic, glass, tile, plastic and concrete pipe, including joints designed to take up movement due to expansion and contraction.

**236 pages, 249 illustrations, $3.00**
In Canada or overseas, $3.72

**PIPE AND TUBE BENDING— by Paul B. Schubert**

Technical data and practical know-how on bending ferrous and non-ferrous pipe and tube in all sizes. Describes types of bending equipment and shows how each is applied to particular jobs. Gives formulas for length and minimum radii of bends.

**183 pages, 159 illustrations, $5.00**
In Canada or overseas, $5.83

**FLUID FLOW IN PIPES— by Clifford McClain**

How to solve problems involving the flow of liquids and gases through pipes. Shows how to handle viscosity, friction, head, and other factors expressed in various dimensional systems. Each phase illustrated with practical examples.

**124 pages, 18 illustrations, $3.00**
In Canada or overseas, $3.70

**SNOW MELTING— by T. Napier Adlam**

A valuable handbook of correct, tested practice that covers the steps in planning, designing, building and operating snow melting systems of all sizes and types.

**224 pages, 189 illustrations, $4.50**
In Canada or overseas, $5.25

**AIR CONDITIONING, HEATING and VENTILATING, 93 Worth St., New York 13, N. Y.**

Please send me the books checked below.

- ☐ HEATING and VENTILATING's ENGINEERING DATABOOK
- ☐ RADIANT HEATING
- ☐ PIPEFITTERS HANDBOOK
- ☐ METHODS OF JOINING PIPE
- ☐ PIPE AND TUBE BENDING
- ☐ FLUID FLOW IN PIPES
- ☐ SNOW MELTING

Name .....

Company .....Street and No. .....

City .....Zone .....State .....

Home Address .....

(Please fill in if you want books sent to your home)

**CHOOSE YOUR MOST CONVENIENT METHOD OF PAYMENT**

☐ I enclose check or money order in full payment. (We pay postage if order is accompanied by payment in full).

☐ I enclose ⅓ down payment (if order amounts to $6.00 or more) and will pay balance in monthly installments. ($6.00 to $9.00, two additional installments. $10.00 to $20.00, three additional installments. $21.00 to $30.00, four additional installments).

☐ Send books on approval. I will pay within five days if I decide to keep books. (Canada and U. S. only.)

ACHV 6/55

*See how All-Air High Velocity units*

# lower the roof

The National Bank of Detroit, which is equipped with an Anemostat All-Air High Velocity distribution system.

This photograph shows the high velocity ducts installed *through* the open web joists. Note how the Anemostat sound attenuation unit is also placed *inside* the open web joist area. As a result, the architects and engineers were able to save *nearly two feet in a one-story building* . . . also make comparable savings in construction costs.

Completed interior with the Anemostat High Velocity units installed in the ceiling.

- *Architect:* W. ROY AKITT
- *Engineer:* F. A. SANDO
- *Mechanical Contractor:* JOHN M. CAMPBELL, INC.
- *Ventilating Contractor:* AUTOTHERM CORP.

• *For latest data on All-Air High Velocity units,* write on your business letterhead for *new Selection Manual 50* to Anemostat Corporation of America, 10 E. 39 Street, New York 16, New York.

## *Facts about All-Air HV units*

- Can be used with smaller than conventional ducts.
- Can be installed through open web joists (as shown here) and in many other space-saving applications.
- Can be installed faster and with less cost.
- Require no coils, thus eliminate clogging and odors.
- Round, square and straight line diffusers with high velocity units are adaptable to a wide variety of architectural designs.

# PRESSURE TIGHT!

***A radiant heating system of Chase® Copper Water Tube protects your reputation!***

Once you install a radiant heating system of Chase Copper Water Tube, you can be sure it's installed *for good!*

Because Chase Copper Water Tube comes in long lengths of 60 to 100 feet, fewer fittings are required – a feature that means easier installation plus a *truly* pressure-tight system!

What's more, the few fittings required are the most leak-proof known – they're solder joints – made with Chase Solder-Joint Fittings. One *more* reason why you can depend on a radiant heating system of *Chase* products!

For more information, write today for the free Chase Radiant Heating Booklet.

**Chase**

**BRASS & COPPER CO.**

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

*The Nation's Headquarters for Brass & Copper*

| | | | | | |
|---|---|---|---|---|---|
| Albany† | Chicago | Detroit | Los Angeles | New York | St. Louis |
| Atlanta | Cincinnati | Grand Rapids† | Milwaukee | Philadelphia | San Francisco |
| Baltimore | Cleveland | Houston | Minneapolis | Pittsburgh | Seattle |
| Boston | Dallas | Indianapolis | Newark | Providence | Waterbury |
| Charlotte† | Denver | Kansas City, Mo. | New Orleans | Rochester† | (Sales office only) |

## *Electronic Air Cleaning vs. Air Filtering?*

# Fact:

## *Test Proves Westinghouse PRECIPITRON Removes Over 5 Times More Airborne Dirt*

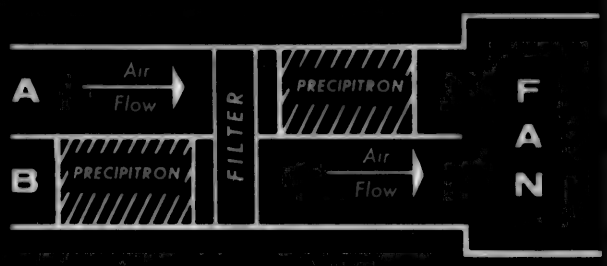



FIGURE 1

FIGURE 2

Dirt scraped from PRECIPITRON cells

**How much better is PRECIPITRON Electronic Air Cleaning for removing dirt particles from air for ventilating and air conditioning?** The answer is shown by this dramatic research test, comparing the performance of a conventional mechanical air filter with PRECIPITRON.

In the test, equal quantities of outdoor air were drawn through two identical channels as shown in Figure 1. In Channel A, air was first filtered and then PRECIPITRON-cleaned. A duplicate filter was placed in Channel B after the PRECIPITRON to balance the air flow.

**After 21 days of operation, a total of 9,000,000 cubic feet of air had passed through each channel.** The accumulated dirt was recovered from the PRECIPITRON collector cells in each channel, and carefully weighed.

In Figure 2, Column B indicates the performance of the two air cleaners in Channel B (PRECIPITRON first). The mechanical filter did not collect any measurable amount of dirt.

Column A indicates the performance of the two air cleaners in Channel A (filter first). **Only 15% of the dirt was removed by the mechanical filter.**

***85% passed through and was trapped by the PRECIPITRON—over 5 times as much, and that portion contained damaging submicroscopic particles.***

**MORE FACTS?** Call your nearest Westinghouse-Sturtevant Sales Engineer . . . he's the "Man with the Facts" on electronic air cleaning . . . or fill in the coupon below.

**WESTINGHOUSE AIR HANDLING**

**YOU CAN BE SURE...IF IT'S**

**Westinghouse**

J-80642

Westinghouse Electric Corporation
Sturtevant Division, Dept. 6E
Hyde Park, Boston 36, Mass.

Please send more facts on your PRECIPITRON.

NAME AND TITLE.....

COMPANY.....

CITY.....STATE.....

# SO YOU HAVE TO BUY A BOILER!

Which one should I buy?
Installation problems
What about service?
Maintenance costs?
Boiler A is cheaper!
Boiler B claims higher efficiency!
Boiler C claims it's best!
Will it be safe for our load?
What to do?
Select an AMESTEAM GENERATOR
and solve all your problems



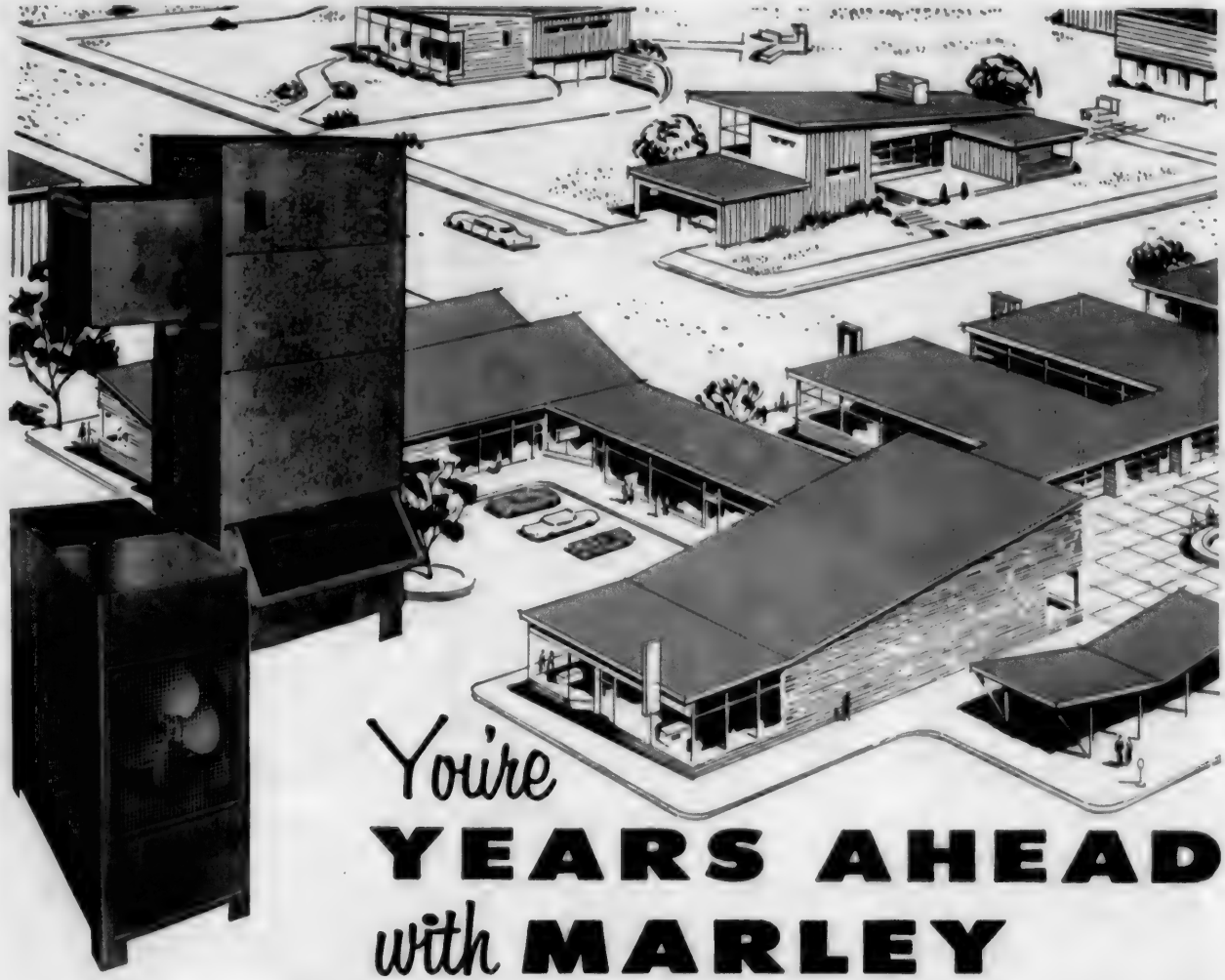
You don't have to dig through mountains of data to pick the boiler that will give your company the most economical and satisfactory service! It's more a question of *where* you buy it than what boiler you choose. What's the maker's reputation?

Ames Iron Works have been building boilers of quality for over 100 years. Back of every Amesteam Generator is this long, successful experience — represented by the Ames Engineering Staff, a large group of skilled boiler makers and an efficient, nation-wide sales and service organization at your disposal. Yes, quality and experience *do* count — and the thousands of Amesteam Generators giving dependable, low-cost service in power, process and heating applications are proof of it. Why not be *sure* by specifying Amesteam Generator? Write today for details and name of your Ames representative.

## AMESTEAM GENERATOR

- 80% guaranteed thermal efficiency.
- Single economical package purchase.
- Package installation economy.
- Completely safeguarded.
- Easy, inexpensive maintenance.
- 20 sizes, 10 to 600 H.P., 15 to 300# W.P., oil, gas or oil-gas combinations with quick fuel switchover feature.

**AMES IRON WORKS, INC.**
BOX C-65, OSWEGO, N. Y.



# You're YEARS AHEAD with MARLEY

Want the very latest? Then there's only *one* line of packaged water cooling towers for you—and that's the '55 Marley line! Every advancement in packaged water cooling is engineered by Marley and all are incorporated in the complete line of '55 AQUATOWERS*. They're years ahead in styling. They're absolutely unmatched in performance.

1955 AQUATOWERS are compatible with surroundings wherever placed. On the ground they have the "appliance look" that home and building owners demand; on roofs or in other locations they are integral parts of the structure. There are no projecting parts; all mechanical equipment is encased and protected. Round corners improve appearance and add structural strength. The durability and performance ability that have made AQUATOWERS the world's standard are retained and enhanced in the '55 line. There is a model for every service from 2 to 60 tons.

For indoor installation where the cooling tower must operate against high external static pressure or for unusual location limitations outdoors, the Marley line includes the new AQUACOOLER*. Duct-work can be attached simply and economically to this all-galvanized counterflow tower. Its design insures its performance: all models have large centrifugal blower fans, balanced spray systems utilizing patented Marley bronze nozzles and redwood filling designed for excellent break-up of water. AQUACOOLERS are available in five sizes with capacities from 3 to 15 tons.

So if you and your customers want the maximum in *value*, don't settle for less than the latest in equipment. And Marley's '55 line *is* the latest—in fact, the "last word" in modern packaged water cooling!

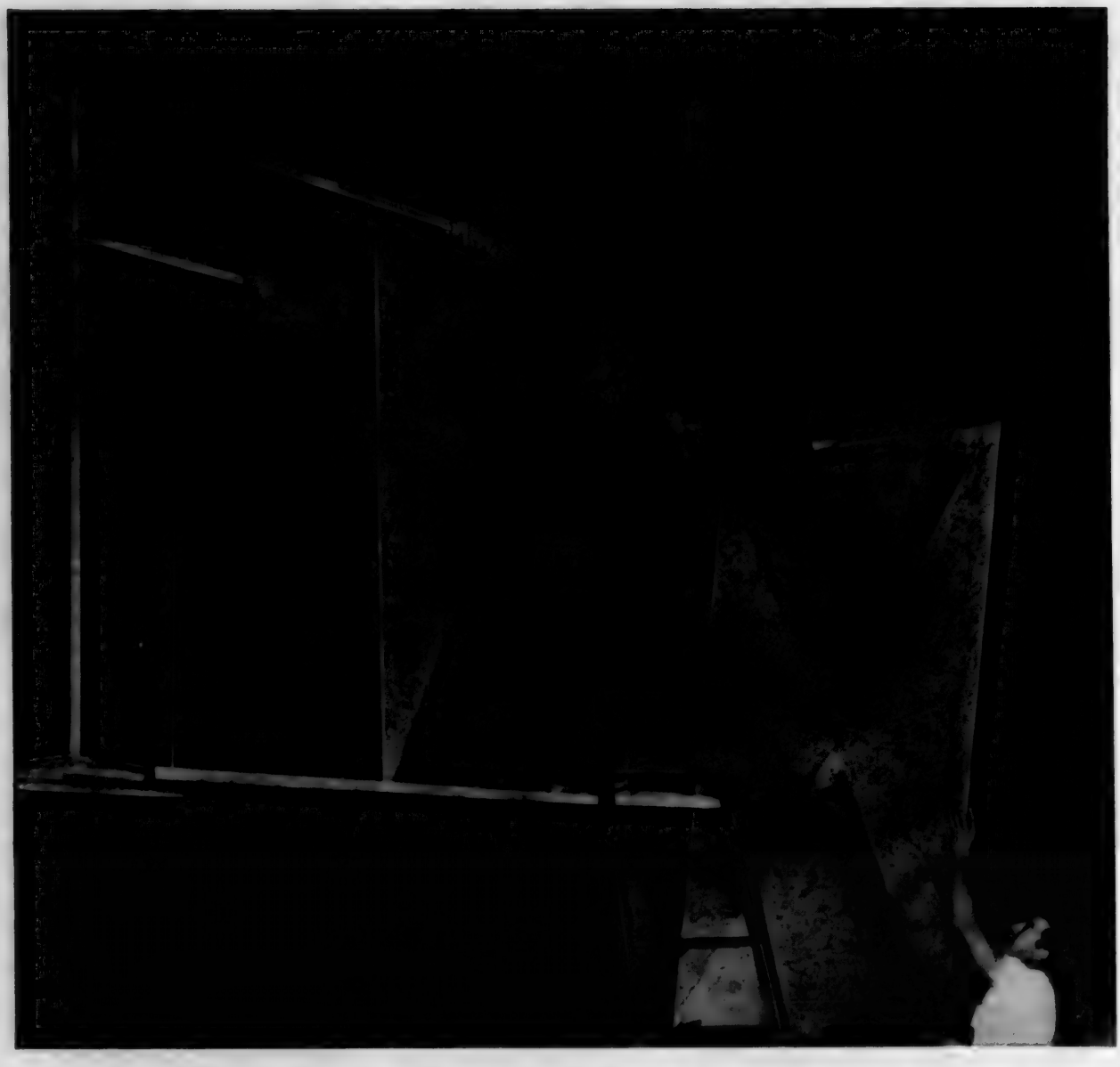
"Nothing cools as well as water . . . nothing cools water as well as a Marley Tower"

MARLEY

**The Marley Company**

Kansas City 14, Missouri

*Trademark Reg.



# Spokane Coliseum is air-conditioned through Bethcon ducts

Opened last autumn, the $2½ million Spokane Coliseum is the largest civic auditorium in the Northwest. Its huge interior will serve 3000 banqueters, or seat 8500 boxing fans . . . in air-conditioned comfort the whole year around.

Carrying conditioned air from plant to public required some 60 tons of ductwork, fabricated of Bethcon galvanized sheet steel by Fox-Smith Sheet Metal Works of Spokane. Bethcon sheets are galvanized in Bethlehem's continuous hot-dip line, and they have a uniform, tight zinc coating that is a delight to the eye. And Bethcon spangles tend to hold their lustre longer. Many sheet-metal men say that Bethcon is superior to any they have ever used in severe drawing or forming operations.

Try Bethcon on the next tough job that comes into your shop. It is made from high-quality cold-rolled open-hearth steel, both plain and copper-bearing. You can get it in gages 18 and lighter, in sheets up to 48 in. wide. For further details, just call our nearest sales office, or drop us a line direct.

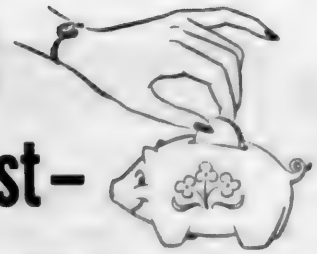
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

**BETHLEHEM STEEL**

BETHLEHEM STEEL

# A lot of comfort At a little cost–

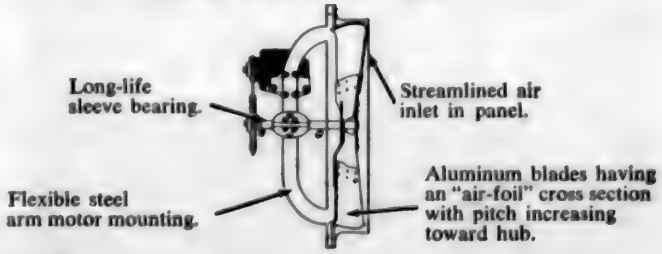


## . . . HERMAN NELSON propeller fans!

### A complete stock of Herman Nelson Propeller Fans is as near as your local Herman Nelson Distributor

Herman Nelson Propeller Fans are your gilt-edge investment in customer satisfaction! From the extensive Herman Nelson line, you'll find sizes, models, capacities to cover every need, from small stores and shops to large industrial plants. Right now, your Herman Nelson distributor is ready to give you experienced help plus quick service! Call on him!

**MADE BETTER TO LAST LONGER**


Long-life sleeve bearing.
Streamlined air inlet in panel.
Flexible steel arm motor mounting.
Aluminum blades having an "air-foil" cross section with pitch increasing toward hub.

AAF herman nelson

**American Air Filter**
**COMPANY, INC.**
General Offices, Louisville, Ky.

## Better Air is Our Business!

AAF **TWIN ROTO-CLONES effectively control dust and fumes given off by leather buffing in this Milwaukee tannery.**

herman nelson **UNIT BLOWERS, in both forward curve and backward curve wheel types, efficiently solve all ventilating and exhaust problems.**

herman nelson **PORTABLE HEATERS supply extra "heat on wheels" at this cold loading dock. There is a size and model for every job, capacities 75,000 to 450,000 BTU.**

### *Write for free literature!*

**AMERICAN AIR FILTER COMPANY, INC.**
**294 Central Avenue, Louisville 8, Kentucky**
Please send me complete information on the following equipment:

- ☐ Propeller Fans
- ☐ Unit Blowers
- ☐ Unit Heaters
- ☐ Electro-Cell Air Filters
- ☐ Dust Collectors
- ☐ Portable Heaters
- ☐ Steam Specialties
- ☐ _____

NAME _____

FIRM NAME _____ POSITION _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

# IN BUSY TIMES SQUARE
## NEW YORK

### RUBY FOO'S INTERNATIONALLY FAMOUS RESTAURANT GETS A PORTMAR TANKLESS VOLUME WATER HEATER

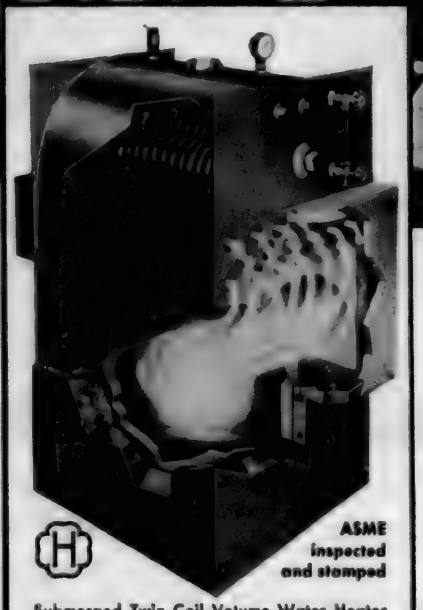
The Dining Room at RUBY FOO'S, West 52nd Street, New York City
Contractor: BERNSLEY HEATING CO., Brooklyn, N. Y.

In New York City's busy Times Square area, Ruby Foo's famous Chinese restaurant, turns over from 600 to 700 meals an hour during peak dinner hours.

A Portmar self-contained volume water heater was installed to replace a hot water storage tank. Instantaneously delivering 180 to 190 degrees sanitary hot water continuously throughout the restaurant's business day — which is 16 hours of continuous hot water demand — the Portmar Tankless satisfies *all* the hot water requirements of the automatic dish washing machines, glass washers, pot washers, towel washers and laundry tubs. The same unit also supplies hot water for lavatories and showers. Today, Ruby Foo's is another satisfied user of Portmar equipment.

A clean, compact, low-cost installation this self-contained volume water heater gets into small spaces, has quick temperature pickup, requires no recovery time. Units deliver large quantities of hot water through submerged twin copper coils for any size and type of building: homes, apartment houses, motels, automatic laundries, restaurants, hotels, hospitals, office buildings, luncheonettes, schools, gymnasiums, factories, processing plants, etc.

Yes, the Portmar Volume Water Heater means plenty of replacement business to contractors . . . plenty of satisfied customers. Units operate economically, reduce high maintenance and increase space-value by eliminating the storage tank.



ASME inspected and stamped

Submerged Twin Coil Volume Water Heater
WH Series, Oil or Gas Fired
9 Sizes—350,000 to 1,650,000 BTU per hour
Hot Water Delivery: 300 to 5,000 G.P.H.

There's a Portmar Boiler or Water Heater for every wet heat job.

**FOR FAST SPOT DELIVERIES,** stocking warehouses in: Philadelphia, Penn. • Watertown, Mass. • Chicago, Ill. • New York, N. Y.

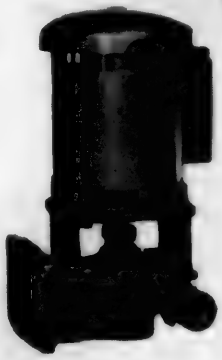
PORTMAR — ENGINEERED QUALITY STEEL BOILERS

SEE YOUR JOBBER, LOCAL PORTMAR REPRESENTATIVE, OR WRITE DIRECT

**Portmar Boiler Company Inc.**

193 SEVENTH STREET
BROOKLYN 15, N. Y.
TR·5·8777

RESIDENTIAL, COMMERCIAL, INDUSTRIAL WATER HEATERS AND HEATING BOILERS • VERTICAL, HORIZONTAL TUBULAR BOILERS • ROTARY FLAME BOILERS



# Now "Domestic" Dependability

## IN A NEW LINE OF

# CENTRIFLO

## GENERAL PURPOSE CENTRIFUGAL PUMPS

**New "CENTRIFLO" pumps by "DOMESTIC". For hot and cold water. Quiet, efficient and compact. Head to 201 feet, capacity to 400 GPM. Bronze fitted, all iron or all bronze. Mechanical seal or packing. Motor 1750 and 3500 RPM; 1 and 3 phase; open, totally enclosed or explosion proof. Flange mounted, vertical or horizontal close coupled.**

WRITE TODAY

BUILDERS OF INDUSTRIAL AND COMMERCIAL PUMPS SINCE 1903

"DOMESTIC"

FOUNDED 1903

DOMESTIC PUMP & MANUFACTURING CORP.

SHIPPENSBURG, PENNSYLVANIA

**Domestic Pump & Manufacturing Corp.**
**Department 2A1**
**Shippensburg, Pennsylvania**

- ☐ Please send me Bulletin 5500 for close coupled centrifugal pumps.
- ☐ Please send me literature on your entire HEATING PUMP LINE.

Name _____

Company _____

Address _____

City _____ Zone ____ State _____

# NEWS!

**NOW YOU CAN CROSS UNSIGHTLY PENTHOUSE TYPE ROOF VENTILATORS OFF YOUR LIST!**

***WITH THESE***

**MODERN CARNES MODELS**

## MODEL CL

This streamlined, low silhouette model is precision-built for smooth, quiet, efficient operation. Plus these outstanding features . . . wide capacity ranges; all-aluminum construction; heavy duty, ball-bearing, protected motors; all models with backwardly inclined, non-overloading centrifugal fan wheels.

## MODEL J

Also designed for today's low parapet buildings, with all-aluminum spun housings to eliminate corrosion and maintenance problems. Features include . . . centrifugal fan wheels statically and dynamically balanced; heavy duty precision pillow block and drive; specially designed vibration isolators. In fan wheel sizes from 24" to 48".

At Carnes, a specially designed building houses complete facilities for expert engineering and thorough testing under actual operating conditions . . . your assurance of the finest quality in every product that bears the Carnes name.

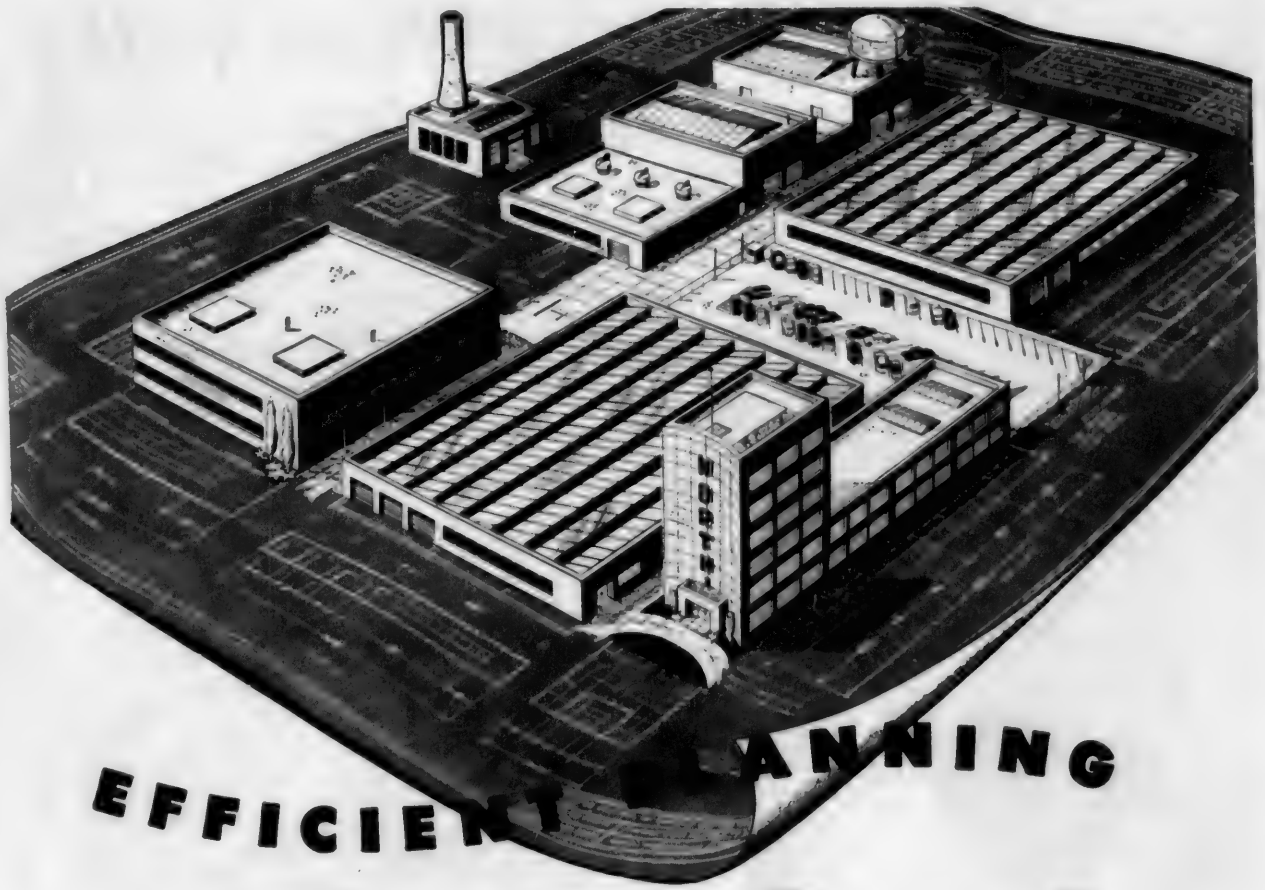
WRITE FOR

**FREE BOOK**

A complete story on Carnes facilities, products and performance data. It's yours for the asking.

# CARNES CORP.

VERONA, WISCONSIN



# EFFICIENT PLANNING Starts with RIC·WIL

● Early planning with a RIC-WIL field representative on central heating or air conditioning systems will mean less work later on. Custom engineering and prefabrication of RIC-WIL units offer quick, efficient installation. RIC-WIL's engineering service with forty-five years experience in the Insulated Piping Field is available for *early* planning and consultation.

Write or phone your nearest representative or send for the illustrated RIC-WIL catalog.

*Quality Piping Systems of the . . .*
*. . . Highest Thermal Efficiency*

**RIC·WIL** INCORPORATED

PREFABRICATED **INSULATED PIPING SYSTEMS**

**BARBERTON, OHIO**

# THIS NEW VACUUM HEATING PUMP IS SIZED TO ACTUAL JOB REQUIREMENTS

## *It's the Nash* CSM

No longer is it necessary for the Engineer to accept a vacuum heating pump with air and water capacities based inflexibly upon square feet of equivalent direct radiation. With the flexible Nash CSM he can provide for proper air capacity in accordance with his judgment and experience. For the individual capacities of the separate pumps on the CSM may be varied within a wide range, without buying an oversize receiver and oversize water pumps.

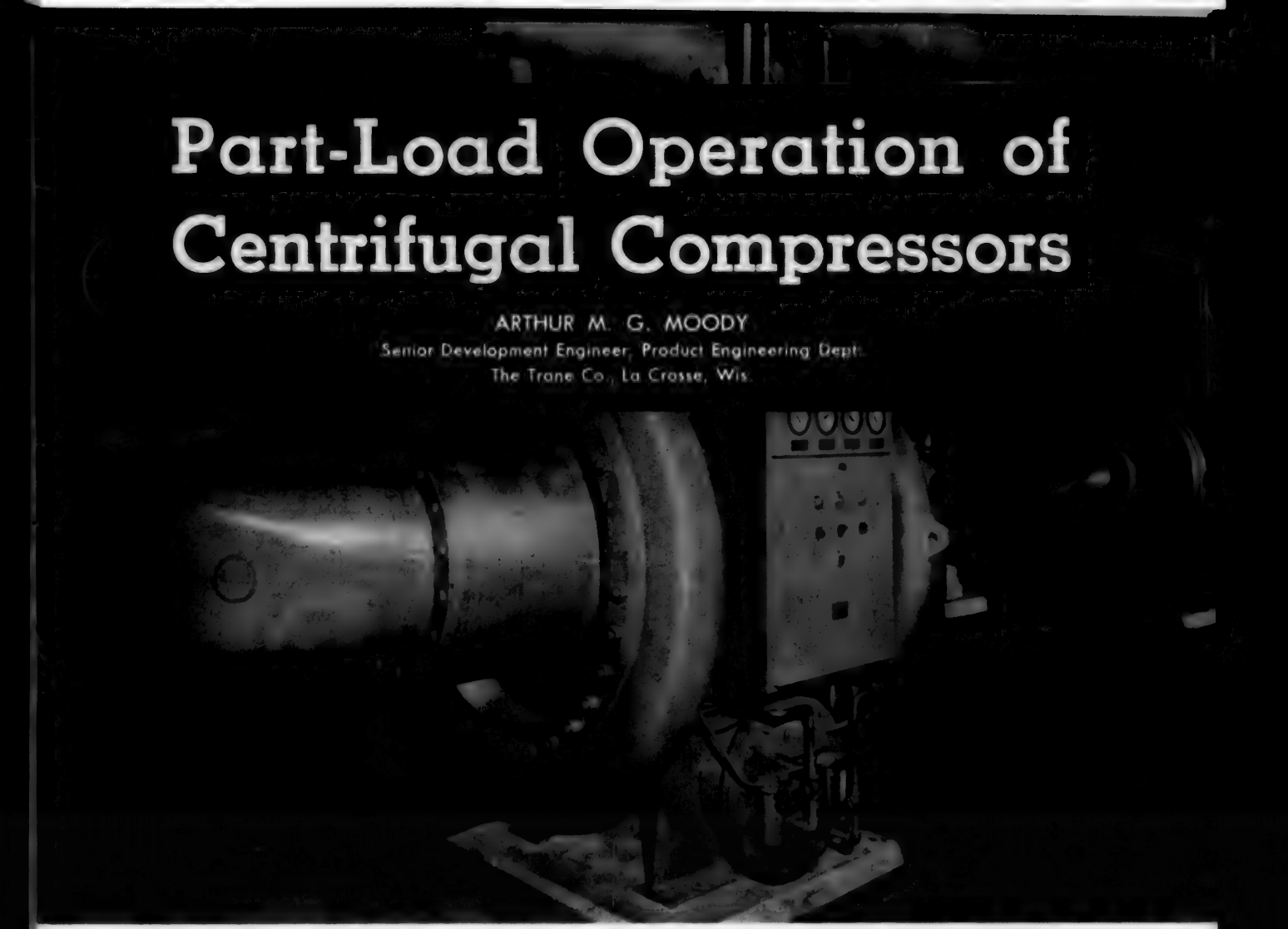
These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low, returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

**NASH ENGINEERING COMPANY**
**438 WILSON, SO. NORWALK, CONN.**

# Part-Load Operation of Centrifugal Compressors

ARTHUR M. G. MOODY
Senior Development Engineer, Product Engineering Dept.
The Trane Co., La Crosse, Wis.



**Various methods of part load operation of centrifugal compressors are described, and the case for controlled inlet vanes is developed with reference to performance.**

THERE are, of course, many reasons why it is important that we be able to vary the capacity of any piece of refrigeration equipment. No cooling load is constant, and particularly on big air conditioning jobs where centrifugal compressors are generally used, seasonal and often daily load variations are tremendous. Hence, the wider the capacity range at which the machine can operate efficiently, the better.

Another common situation in this air conditioning age of ours is that of the big building owner who wants to air condition his building gradually, floor by floor, with minimum disturbance to his tenants. Naturally, he wants to be able to keep the operating costs on his water chiller somewhat in line with the capacity he actually needs to provide cooling to the floors where the remote air handling units are installed.

As long as centrifugal compressors have been used for refrigeration, various means have been devised to accomplish part-load operation. Unfortunately, the problem has always been complicated by a very nasty trait of centrifugal compressors: they require large volumes of gas, and they must have it or they raise rather violent objections. I will say more about this a little later, but right now, let's consider for a moment some of the possible methods of controlling the output of these machines.

Of course, the simplest thing we can do is just what our kitchen refrigerator does—have our compressors cycle on and off as necessary. But all we have to do is take a good look at the electrical characteristics and cost of the motors and starters used to provide up to 1,000 hp to see why no one would be very happy with this arrangement.

Frequent starting can result in increased wear and maintenance on the equipment. The motor will overheat and this will materially shorten its life. Large starters are designed for a limited number of starts per hour, beyond which overheating and even damaged parts may result. The power companies would be most unhappy about the rapid load changes which would be put on their power distribution system. Nearby tenants would say awful things about us because even the quietest running centrifugals make some noise when they start and stop.

No, centrifugal refrigeration compressors are generally big machines with big motors and starters and should be kept running as much as possible.

Fortunately there are methods of controlling compressor capacity other than running them like mad for a few minutes and then shutting them off. For example, we can use suction dampers in the compressor inlet.

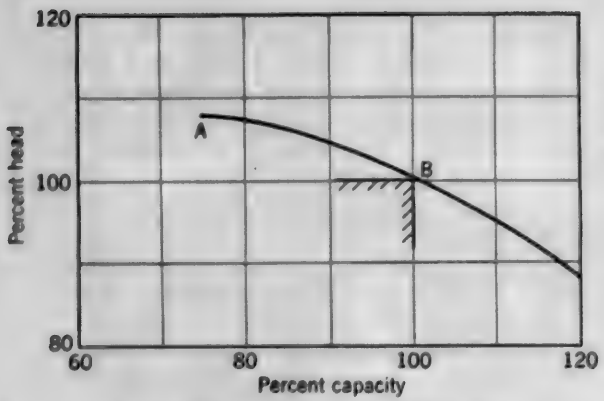



Fig. 1. Head-capacity curve for typical unit.

To understand this method, we must consider in more detail the requirement these compressors have for a lot of gas. Figure 1 shows an actual curve of head and capacity for a typical 150 hp unit. We see that this curve only goes down to about 75% of full load capacity. Why doesn't it go any lower? The answer lies in that nasty trait already mentioned—centrifugals use lots of gas.

They carry this to a practically absurd degree. They not only like lots of gas, but when they are designed to operate at a certain capacity, they refuse to operate on much less than the design gas quantity. Their refusal takes a very conspicuous form; they make a tremendous racket and their discharge pressure fluctuates violently. This phenomenon is known variously as "surging," "pulsation" or "pumping."

It is caused by stalling inside a compressor. We know that when an airplane tries to fly too slowly it stalls. The centrifugal is a little like the airplane wing, but instead of the wing moving through the air, the gas moves past the impeller.

Figure 2 shows a section through the inlet edge of the vanes of an impeller. The three small diagrams represent the progress from full capacity where the passage is nicely filled, to reduced capacity where the gas is pulling away, to surge in the final case where stall has set in. Under these conditions the impeller does not admit any gas until enough has piled up in front to restore proper flow momentarily. The impeller then takes a big gulp and immediately finds itself out of breath again.

Consequently, the point "A" on the compressor curve

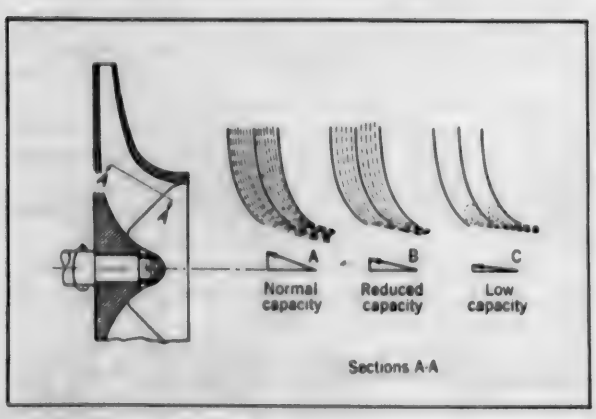



Fig. 2. Compressor surge.

**Arthur M. G. Moody is senior development engineer in the Product Engineering Department of The Trane Co., La Crosse, Wis. A native of Troy, New York, he received both his Bachelor's and Master's degrees in mechanical engineering from Princeton University. His background in centrifugals dates back quite a few years, having served as chief research engineer for the De Laval Steam Turbine Company and subsequently, from 1945 to 1952 as chief engineer of the Blower Division of the Elliott Company. He joined The Trane Company in 1952. He has written numerous technical papers in ASME publications and other trade journals; he has received two certificates of merit from the ASME and he is listed in Who's Who in Engineering. He is on the executive committee of ASME and is a member of several other technical societies; he is also very active in civic and church affairs in La Crosse. He is one of those rare engineers whose technical abilities and interests are shared by a love for the arts.**

in Fig. 1 represents the end of the line for practical operation.

Now let's get back to the suction damper. We know that when we want to land a plane, we want it to go pretty slow, so we use landing flaps to mess up the air flow over the wings. With a centrifugal compressor we can do something like this, that is, put a butterfly damper ahead of it and mess up the flow of gas into it by creating a resistance. This is pretty crude, and it doesn't give very good efficiency, but it's not costly and it does provide a means of control with a slight improvement in the stable operating range. Unfortunately, we can't get much less than perhaps 45% of full capacity this way.

## Design for Less Than Full Capacity

Another method of controlling capacity is to design for less than rated capacity and use oversize impellers to get rated capacity.

Let's look for a moment at the curves in Fig. 3. We can design a compressor for best efficiency at point "C" (70% capacity) on the lower performance curve and in this way point "A" can be moved as far forward as about 53% capacity. The only trouble is that the impeller which produces this curve won't develop enough head to provide 100% capacity, so to get around this we must use oversize impellers and raise the whole curve

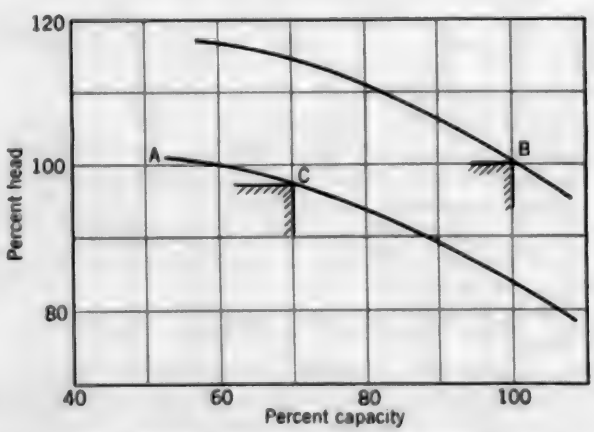



Fig. 3. Head-capacity curves, modified design.

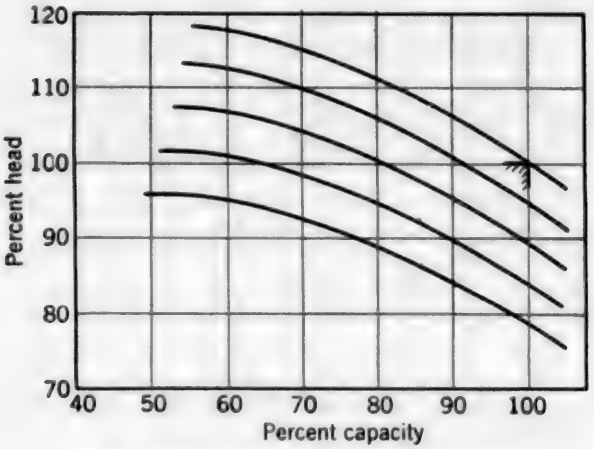



Fig. 4. Head-capacity curves, variable speed.

until we get 100% capacity at point "B." Unfortunately, however, this is a less efficient point than "C" and about 5% more power is required at full load than if we had selected our compressor at the proper point.

Since neither this method nor the suction damper by itself provides a sufficiently wide range of capacity control, the two are often used together to provide an operating range down to about 25% capacity.

### Variable Speed

Another solution to the problem is, of course, the use of variable speed drivers such as wound rotor motors or fluid couplings. Reducing the speed of a compressor has the effect of reducing both its head and capacity. Figure 4 shows typical head-capacity curves for 5 different compressor speeds. We can see from these curves that at any given speed, the head developed by the compressor increases as the load decreases. It is also true that at reduced load we need less head because the condensing pressure is down. Since we therefore have excess head, we can reduce the speed quite a bit. This has the same effect as reducing the size of the impeller.

With this method, the improvement in the capacity range is not great, but it is highly efficient, as far as the compressor is concerned.

Speed control is often used in combination with other methods to increase the capacity control range; its main disadvantage is that all motor-driven variable-speed devices reduce the over-all efficiency of the refrigeration unit.

### Hot Gas Bypass

One device which permits operation close to zero load is the hot gas bypass. This is simply a matter of running a pipe from the compressor discharge back to the suction. By installing a couple of valves, we can divert any part or all of the hot discharge gas through this bypass, so the flow of refrigerant to the condenser and evaporator can be practically stopped.

Since its cfm requirement for gas is satisfied, the compressor is happy but the motor sees no reduction in power so it isn't quite so happy with this method.

So far we have mentioned several things that can be done to reduce capacity, all somewhat helpful, but all with some definite disadvantages. Fortunately, the problem isn't quite as unsolvable as it may seem. In fact, like most problems, it has a satisfactory solution.

### Prerotation Guide Vanes

The use of adjustable inlet guide vanes ahead of each compression stage gives us the two things we want the most: (1) it permits operation at loads down to 10% capacity and (2) it gives us excellent operating economy. The theory behind this method is that when the entering gas is prerotated (spun), a centrifugal compressor for some strange reason can get along with less cfm than otherwise. Without guide vanes, a given design compressor might need 2,000 to 5,000 cfm, but with prerotation vanes, the minimum volume might be as low as 1,000 or 1,500 cfm. We get prerotation of the gas by turning the guide vanes to various angles. This throttles the gas flow and at the same time directs its flow in the direction of wheel rotation. The impeller doesn't take quite as big a bite, and the head developed by the impeller is reduced without introducing a large loss.

Figure 5 shows what the guide vanes do for the compressor. As the vanes move from 90° opening (full-open) to 20° opening, we in effect draw a whole set of new performance curves, with reduced head and capacity, and each with good efficiency. The dotted line at the top is the surge line; that is, the locus of the surge points. It also shows how the head decreases at reduced loads.

Stability of operation is another important feature of this method. Referring still to Fig. 5, suppose point "A" is the design point. Now consider operation at a reduced load. If we keep the same evaporating and condensing temperatures, we will have the same head and thus will move along the line A-B, which is in the surge range. But, if we keep the same water flow through the condenser, the leaving water temperature decreases. In addition, the approaches in both the evaporator and condenser improve, so that the head decreases, and we move along the line A-C. This remains always within the stable range.

So here is a method of part-load operation by which we can go down to 10% capacity and still stay in the stable and efficient range of operation. It is somewhat

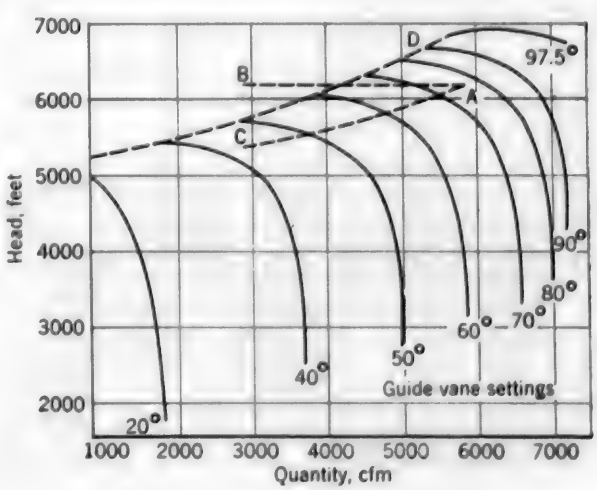



Fig. 5. Head-capacity curves with guide vanes.

below the 10% figure that the flow of gas becomes so low that surging occurs.

Sometimes design limitations of a particular compressor prevent use of guide vanes ahead of both stages and they are placed ahead of only the first stage. Unfortunately, the reduction in capacity which can be achieved this way is not great enough, so one or more of the other less desirable methods must also be used and efficiency naturally suffers.

Let us look now at the performance we can obtain by using variable inlet vanes ahead of both stages of a compressor.

If we examine horsepower and kilowatt input curves, we see that the major advantage of this method is that power input runs almost proportional to the load. In Fig. 6, both kilowatt input and brake horsepower are plotted against load. Note that these are all in terms of percentage of full load. Here we see that at 10% load, brake horsepower is about 13% and kw input is about 17% of full load. The kw input is higher than the bhp at the lower end of the capacity range because motors are less efficient when operating at light loads than at nameplate rating loads.

In order to compare part-load performance costs for several of the capacity control methods we have been discussing, let's look at the curves in Fig. 7.

Curve A shows percentage of full kw input to a synchronous-motor-driven compressor with prerotation vane control ahead of only one of the two compression stages. This unit is also designed for less than rated capacity and uses an oversize impeller.

Curve B depicts typical part load compressor performance with a combination of suction damper control, variable speed motor control, and a hot gas bypass. In this particular case, the hot gas bypass comes into play at about 18% load, and of course there is no further power reduction down to minimum load.

Curve C was drawn from readings on a compressor which is equipped with prerotation vanes ahead of one compression stage, and has variable speed control through a slip-ring motor. Unfortunately, the slip-ring

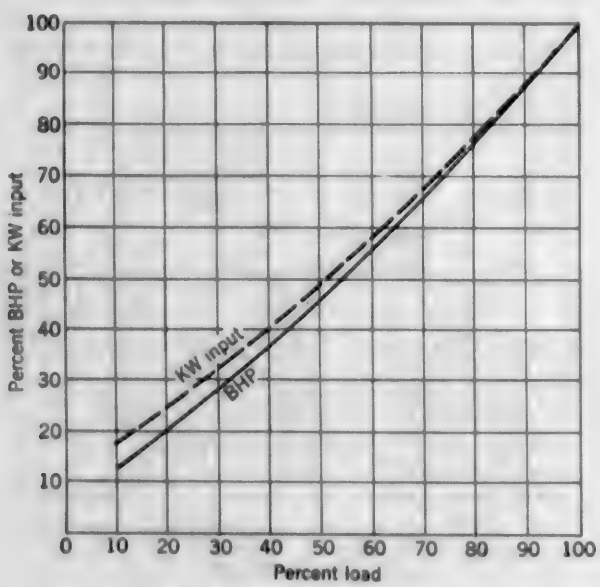


Fig. 6. Load ratio curves.

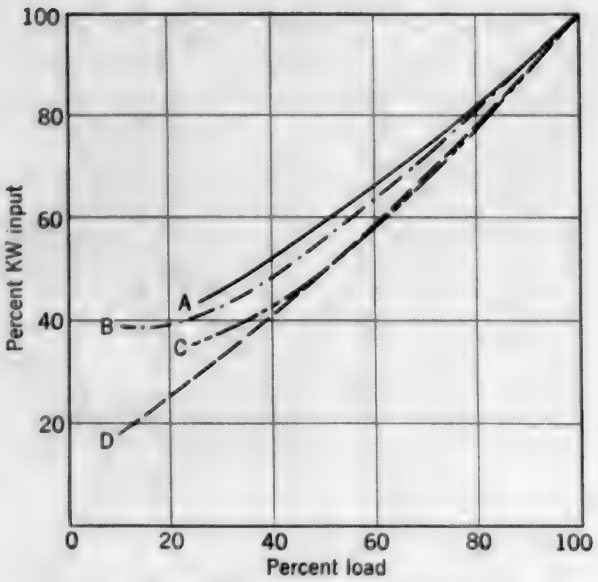


Fig. 7. Part load performances compared.

motor is inefficient at low speeds, its efficiency dropping in proportion to the slip.

Curve D is for a centrifugal compressor with prerotation vane control before both stages, and which is driven by a squirrel cage motor direct-connected to both impellers.

The only thing wrong with these curves is that they don't really show the full extent of the power savings of the vane-control method. This is because the compressors represented by curves A, B, and C require about 5% to 10% more power at full load, mainly because they are designed for maximum efficiency at less than full load. Since these are all percentage curves, this difference is not shown.

Incidentally, Curve D is based on a compressor operating without an economizer, an intermediate pressure chamber which returns flash gas to the second stage impeller. By using an economizer, the bhp and kw input curves can be improved even further. Depending upon the interest in operating costs, the use of an economizer may or may not be desirable.

## Method of Control

The shafts on which the vanes are mounted are moved simultaneously by actuator rings mounted on the housing. These rings are moved through a mechanical linkage by a pneumatic vane operator. The exact position of the vanes, from fully closed to fully open, is determined by the refrigeration load requirements as indicated by a pneumatic temperature controller located in the chilled water line leaving the unit.

Control from the leaving chilled water temperature provides an immediate measure of the machine performance. If the leaving water temperature changes even slightly, the change will be felt immediately in the control system and the inlet vanes will be adjusted to balance the capacity accordingly.

Accurate control in this way is possible only if the compressor has an infinite number of steps of capacity such as the inlet vane method permits.

# Liquid Heating and Cooling for Year-Round Air Conditioning

W. B. COOPER

Manager, Heating and Cooling Products, Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., New York, N. Y.

**Remote type room units provide individual room control for year-round air conditioning systems. Information is presented regardng the common types of systems and how to determine water flow rate, water temperature and other design factors. Basic points are given for good design and installation practice.**

IN recent years, systems of air conditioning using piping to convey the cooling or heating medium from the central plant to room units has become increasingly popular. Such a system consists of a central heating plant and a central plant source for cooling. These are connected by piping to individual room remote type air conditioning units. This piping, of course, is insulated so that when carrying cold water for summer air conditioning, condensation does not occur on the outside of the piping.

**TABLE 1—NOMINAL RATINGS FOR ROOM UNITS**

| Air Cap. Cfm | Cool. Cap.* Btu per Hr | | Air Vol. - Cfm Meas. at 70 Deg. | | Water Rate Gpm | Heating* | |
|---|---|---|---|---|---|---|---|
| High Speed | Sensible Heat | Total Heat | Total | Max. Outside Air | | Output Btu per Hr High Speed | Water Temp. Drop, Deg |
| 200 | 4,930 | 7,100 | 210 | 60 | 1.41 | 15,840 | 22.5 |
| 300 | 6,730 | 9,440 | 300 | 75 | 1.92 | 20,520 | 21.5 |
| 400 | 9,750 | 16,200 | 400 | 100 | 3.24 | 34,300 | 21.2 |
| 600 | 14,800 | 22,600 | 610 | 130 | 4.52 | 47,520 | 21.1 |

*Typical cooling conditions of 85 deg db, 70 deg wb entering air mixture temperature; 45 deg entering water temperature, 10 deg temperature rise. Typical heating conditions of 60 deg entering air mixture temperature, 180 deg entering water temperature, while maintaining the same gpm water rate as with cooling.

These systems involving individual room remote type air conditioning units have been particularly popular in air conditioning multi-room installations, apartment houses, hospitals, hotels, motels and office building, as well as many other types of multi-room commercial buildings. In rooms in these structures, the internal loads are light and loads at the periphery of the building vary to quite wide limits during the 24-hour schedule and from season to season.

It has been considered good practice in the air conditioning of buildings to assume an average comfort condition for the interior spaces, based on certain tests with which many are familiar. The individuals tested, in many cases, varied widely in their interpretation of comfort conditions. Thus in most buildings there are some people who are most comfortable at an inside temperature of 85F deg on a hot summer day and there will be some people in the building who desire the temperature in their room at 75 deg. To provide for these individual differences, it is now becoming increasingly common to provide individual room control. Therefore, the remote room unit type system was developed particularly to fit the needs of this new trend towards personalized comfort. Such systems have increased in popularity because they save space, they provide flexibility of design, they may be controlled by a large number of different means to fit the conditions of the job, and these systems are usually considered to have long life.

## Room Unit and Connections

Before getting into a detailed discussion of the system let us first consider the room unit illustrated in Fig. 1. This is the most evident part of the overall air conditioning system, as far as the occupant or tenant is concerned. These units consist primarily of a motor driven blower, a water coil, a supply outlet grille, a filter and an enclosure or cabinet. Outside air can enter the rear of the unit through a wall aperture, return air can enter the front of the unit. Air from the two supplies passes through the filter and are mixed; the air is blown over the coil surface for conditioning. Either manual or automatic control may be provided so that the amount of conditioning supplied by the room units at any particular time can be varied to suit existing load contitions and also the desires of the occupant.

Four methods of connecting these room units to the central plant equipment are illustrated in Fig. 2. Although there are a number of variations to the piping arrangements, in general a system of reverse return type of piping is used so that there is approximately equal circuit resistance through all units. For heating, the circulating pump draws the water through the hot water source at the central plant and forces it through the individual room units.

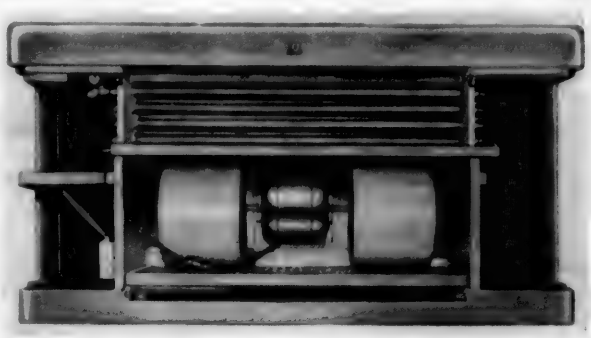


Fig. 1. Cover of a room unit removed to show blower, water coil and other details.

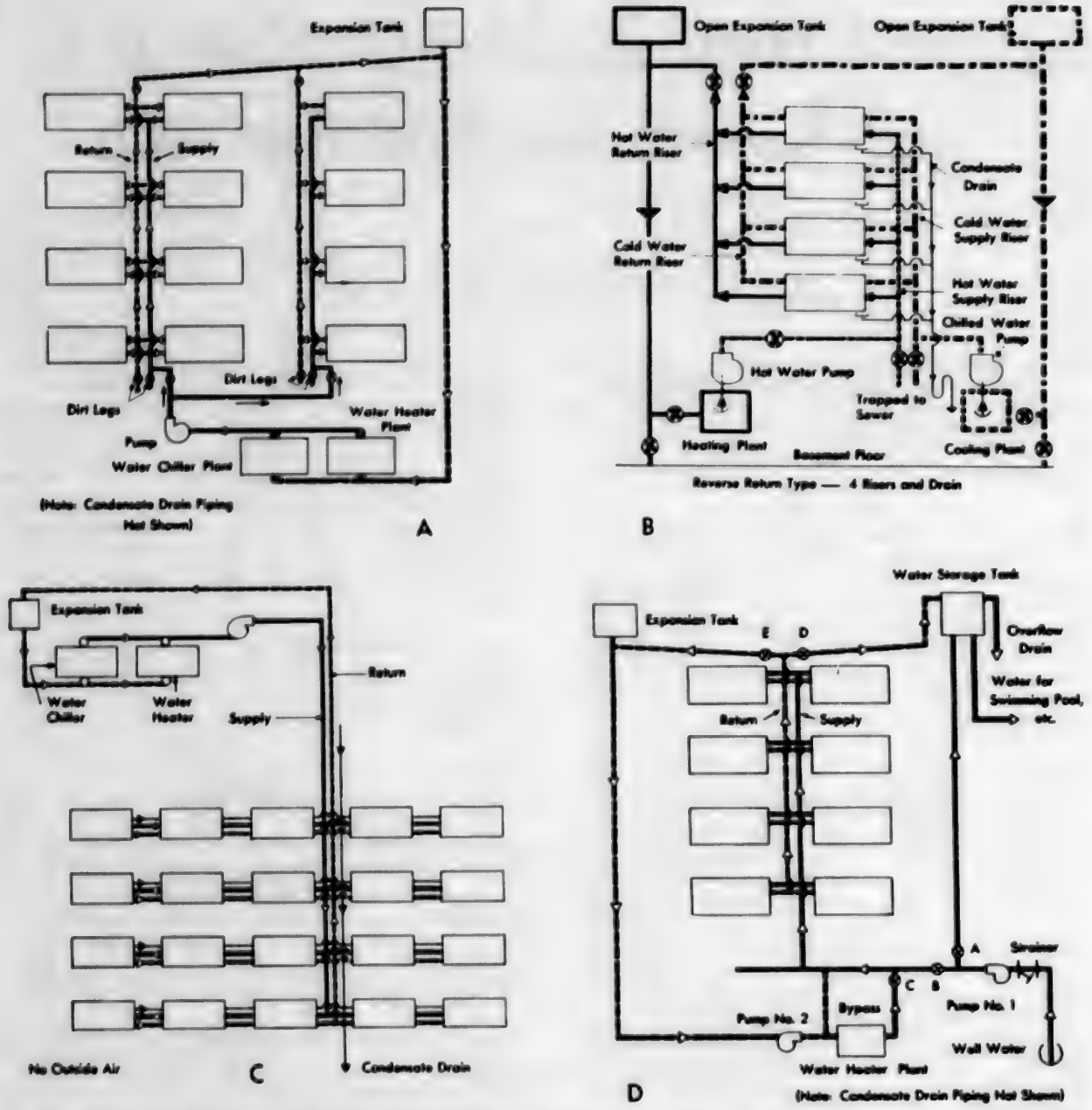



Fig. 2. Typical piping arrangements for chilled water systems: A, conventional system; B, split-coil piping system; C, modernization system; D, well water system.

After the air has been heated, the lower temperature water leaves the individual room units and flows back through the return piping system to the central heating plant, thus completing the circuit. For summer cooling, the piping circuit is similar with exception that water travels through the central plant water cooler rather than the heater. All of these systems have some type of expansion tank piped into the circuit to take care of expansion and contraction. Obviously, the system using well water, does not have a central plant water cooler.

Although nominal ratings for these units are available and typical ones are listed in Table 1, due to variations in job conditions, it is generally good practice for the engineer to plot the conditions on a typical chart and determine accurately the performance of the unit. (See Fig. 3, 4 and 5).

## Finding the Water Flow Rate

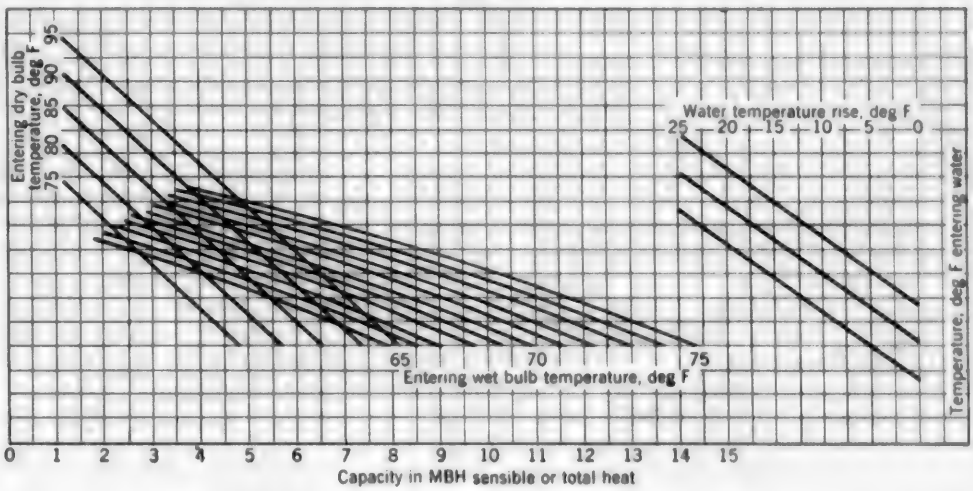
On most of these systems, the same quantity of water is used for both cooling and heating. Since the cooling water quantities are usually higher than heating water quantities, it is common practice to determine water quantities from the cooling load and to adjust the hot water temperature based on maintaining the same flow for heating. Illustrated are performance charts for a 200 cfm, 400 cfm, and a 600 cfm remote unit. The procedure for using one of these charts (Fig. 4) is as follows:

1. Enter the cooling chart (high fan speed) for the room unit selected at the design sensible heat gain in MBH and proceed vertically upward. Locate a point at the design entering dry bulb temperature indicated by the entering dry bulb temperature curves.

2. From the above established point, proceed horizontally to the right and locate a point at the design entering water temperature indicated by the entering water temperature curves.
3. Proceed vertically upward and read the water temperature rise through the coil.
4. To obtain the total capacity of the unit, determine the intersection of the horizontal line established in 1 and 2 with the entering air wet bulb line. From this intersection point, move vertically downward and read the total heat capacity in MBH.
5. Determine the water flow rate in gpm by dividing the design total heat gain in Btuh by the water temperature rise times 500.

**W. B. Cooper, at present manager, Heating and Cooling Products, Plumbing and Heating Division, American Radiator & Standard Sanitary Corporation, started with Westinghouse Electric Corp., Springfield, Mass., in 1938 as application engineer in the Air Conditioning Division. Later he became Commercial Sales Manager, York Corp., Southeastern Division at the Atlanta, Ga., office. He has had broad experience in air conditioning sales and application engineering. He is a member of ASHAE and ASRE.**

Fig. 3. Cooling chart for a remote type unit with a high fan speed delivering 200 cfm.


Entering dry bulb temperature, deg F
75 80 85 90 95
Water temperature rise, deg F
25 20 15 10 5 0
65 70 75
Entering wet bulb temperature, deg F
Temperature, deg F entering water
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Capacity in MBH sensible or total heat

### Heating Water Temperature

To determine the proper heating water temperature proceed as follows, as indicated in Fig. 6, 7 and 8:

1. Enter the heating chart for the room unit selected (for example, Fig. 7) at the same water flow rate as determined for cooling and proceed vertically to the desired air flow rate curve.
2. Read horizontally to the left the heating capacity factor.
3. Divide the design winter heat loss in Btuh by the heating capacity factor to determine the effective temperature difference (the difference between the entering water temperature and entering air temperature).

$$\text{Effective Temperature Difference, degF} = \frac{\text{Total Heat Loss}}{\text{Heating Capacity Factor}}$$

4. Add the effective temperature difference to the entering air temperature to determine the entering water temperature in degrees.

### Heating on Gravity Flow

Each of these units has some gravity air flow on heating when the fan is not running. By using the graph, Fig. 9, the quantity of heat on gravity flow can be determined. This is done as follows:

1. Enter the heating chart (fans not running), Fig. 9, at the same water flow rate as determined for cooling and proceed vertically to the desired room unit curve.

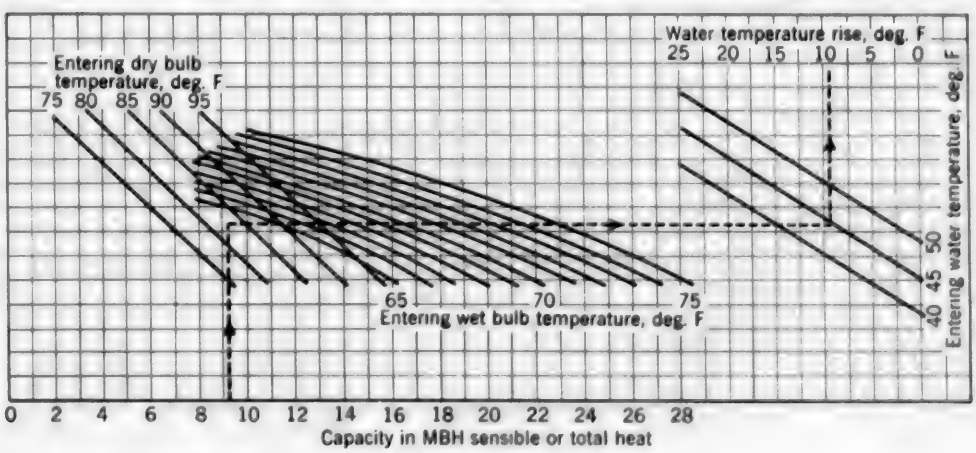

Entering dry bulb temperature, deg. F
75 80 85 90 95
Water temperature rise, deg. F
25 20 15 10 5 0
65 70 75
Entering wet bulb temperature, deg. F
40 45 50
Entering water temperature, deg. F
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Capacity in MBH sensible or total heat

Fig. 4. Cooling chart for a remote type unit with a high fan speed delivering 400 cfm.

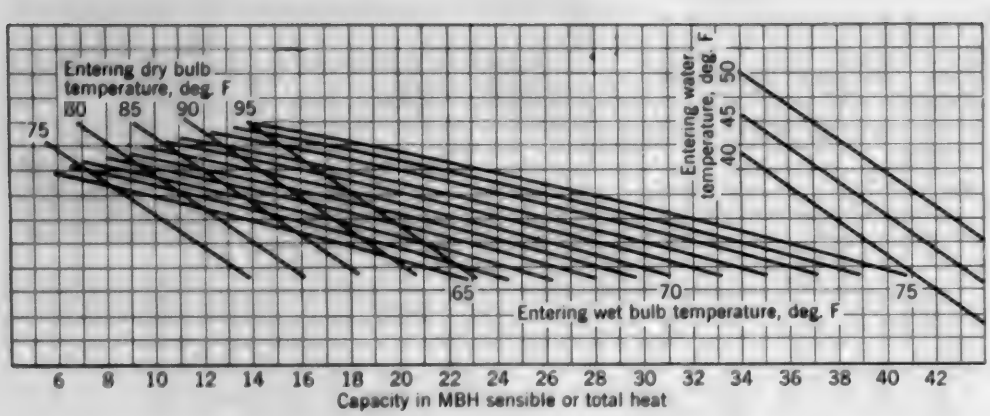



Fig. 5. Cooling chart for a remote type unit with a high fan speed delivering 600 cfm.

2. Read horizontally to the left, the heating capacity factor.
3. Multiply the heating capacity factor by the effective temperature difference (the difference between the entering water and entering air temperatures), to determine the heating capacity in Btuh of the unit operating with the fans not running.

Heating Capacity (Btuh) =

Heating Capacity Factor × E. T. D.

Suitable charts are also available for determining the water pressure drop through the equipment, this is important in sizing the piping and selecting the proper circulating pump.

### Packaged Water Chillers

Recently there has been a decided trend towards the use of packaged water chillers, completely assembled at the factory and ready for use after suitable connections have been made on the job. These chillers usually consist of a water cooled compressor, a dry expansion type chiller, suitable piping, insulation, and controls, all mounted on a common frame work. In general, these packaged chillers are equipped with capacity reduction on the compressor so that the capacity may vary depending upon the load conditions. Some type of arrangement, such as solenoid valves in the liquid line, are provided to prevent liquid damaging the compressor during the shut-down.

One of the great advantages of using the packaged chillers is the fact that the various parts of the unit have been carefully matched and that the combined performance of the equipment has been tested. Ratings on the complete combination of the assembled parts have been determined by actual tests. A typical capacity rating graph for a 40 hp packaged water chiller using refrigerent F-22, is given in Fig. 10. This same information is also available in table form. The curves permit the engineer to obtain performance over a wider range of conditions.

### Performance of Packaged Chillers

The curves of Fig. 10 indicate the over-all performance of the packaged chiller under a number of conditions. Actually, this is a composite curve including a performance curve of the condensing unit and performance curve of the chiller. The points that are of interest in so far as the packaged chiller is concerned, are the intersection points between these two sets of curves.

The condensing unit curves are drawn for these condensing temperatures—95, 100 and 105 deg F. The chiller curves have been drawn for three water-off temperatures—42, 45 and 48 deg. For each water-off temperature chiller performance, curves are drawn for various temperature drops through chiller of 8, 10 and 12 deg.

A single intersection of these curves indicates the combined performance of the equipment at that particular set of conditions. For example, refer to the circled point of Fig. 10. At this point with a 10 deg drop through the chiller, water entering the chiller is at 55 deg and the water-off the chiller is 45 deg. The condensing unit is operating at 105 deg condensing temperature and producing 43.6 tons of refrigeration at an evaporating temperature of 34.8 deg.

Note that the capacity of the chiller can be increased by selecting the higher evaporator temperature, or a high temperature rise through the chiller. In general the engineer does not have this wide range of flexibility in selecting the chiller because certain of these conditions are determined by the design used in selecting the individual room units and other limiting conditions of the installation.

In specifying packaged chiller equipment, it is important to give certain basic information. This should include the cooling capacity of the equipment in tons, the

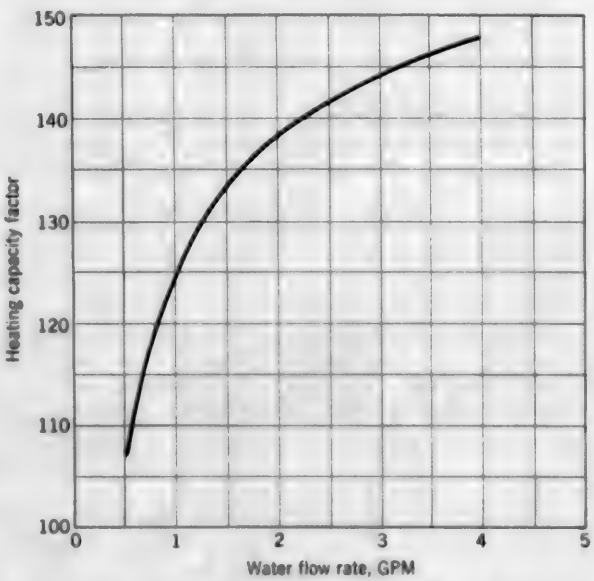



Fig. 6. Heating capacity factors for a high fan speed delivering 200 cfm.

gpm flow through the chiller, the temperature of the water entering the chiller, the temperature of the water leaving the chiller, the gpm of condenser water available, and the temperature of the condenser water.

As indicated previously, many of the most recent designs of packaged water chillers use F-22 refrigerant. This has been found to give a greater horsepower per ton than systems using F-12. To illustrate this, a typical curve of an F-12 chiller is shown in Fig. 11. Note the difference between Fig. 10 and 11 on the basis of horsepower per ton of cooling.

Normally with packaged chillers the standard condenser flow is based on 20 deg difference between condensing temperature and entering water temperature. If the condensing temperature is 105 deg, these flow ratings would be based on a water temperature of 85 deg.

Where high temperature condensing water is available, it is general practice to connect the condenser in parallel thus reducing the number of passes and thereby maintaining a lower water pressure drop. Where small volume of water for the condenser can be used the best performance is gained through a series type connection which increases the number of passes.

## Control

Since these liquid type heating cooling systems provide individual room temperature to suit the occupants, the selection of the proper controls is extremely important. These vary greatly from job to job. The least expensive

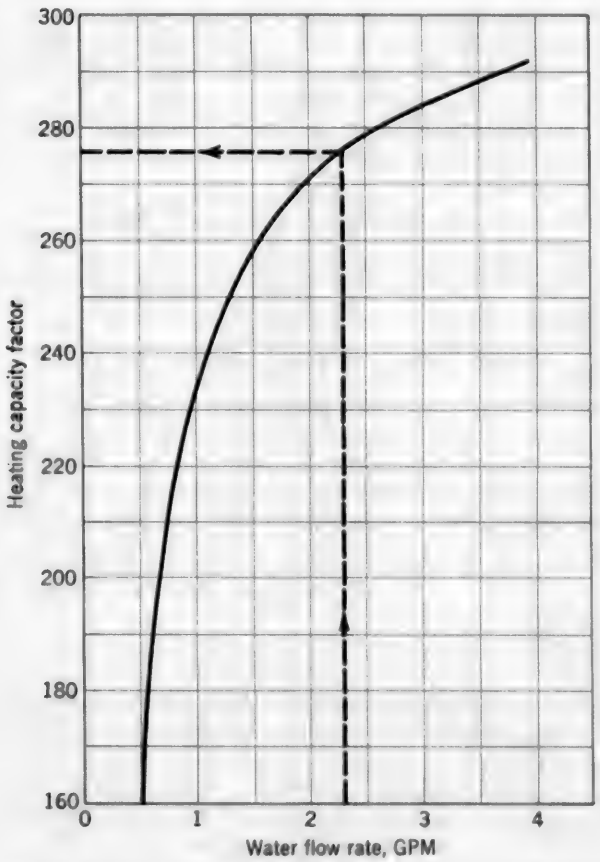



Fig. 7. Heating capacity factors for a high fan speed delivering 400 cfm.

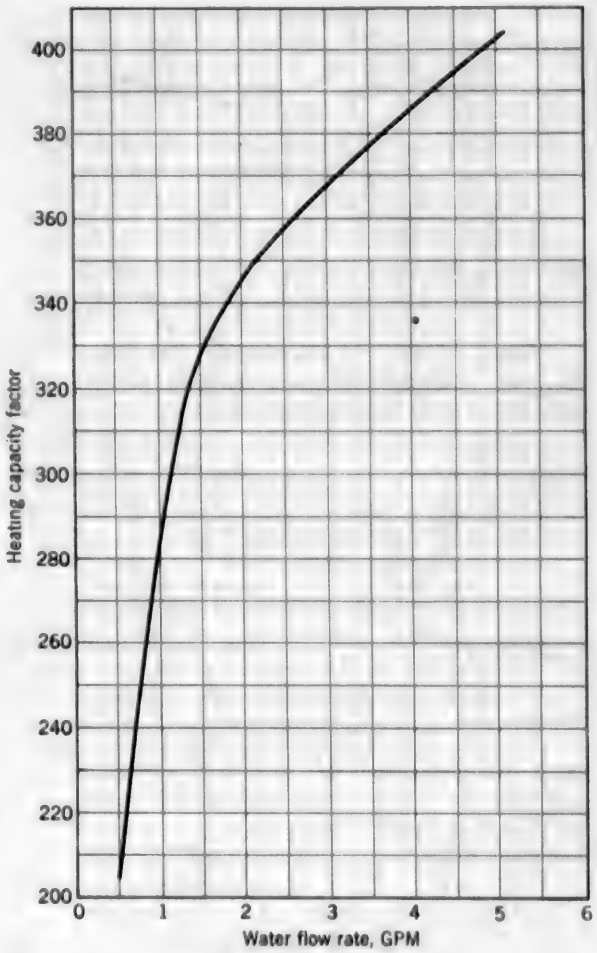



Fig. 8. Heating capacity factors for a high fan speed delivering 600 cfm.

type control, of course, is manual control. These manual controls can regulate the speed of the fan or the quantity of water flowing in through the individual room units. In so far as automatic controls are concerned, the most popular is the wall thermostat that automatically turns the fan on and off in response to the thermostat setting. One other very popular type control is a self-contained temperature control with the bulb located in the return air stream that automatically turns off the water supplied to the unit by use of a solenoid valve in the water line, in response to the needs of the thermostat.

From these somewhat basic types of control there are also a number of more elaborate automatic controls which are particularly useful on certain types of jobs. One of these, which is very common, is the use of pneumatic controls. These usually consist of modulating the water valve, regulated by either a self-contained control or a room thermostat.

There is at the present time a purely mechanical type water regulating control that not only modulates the water supply to the unit but provides automatic changeover of the thermostat action from heating to cooling.

Arrangements are also available so that the outside air damper may be controlled by a damper motor in response to either outside conditions or to provide greater or lesser quantities of outside air during certain periods the system is operating.

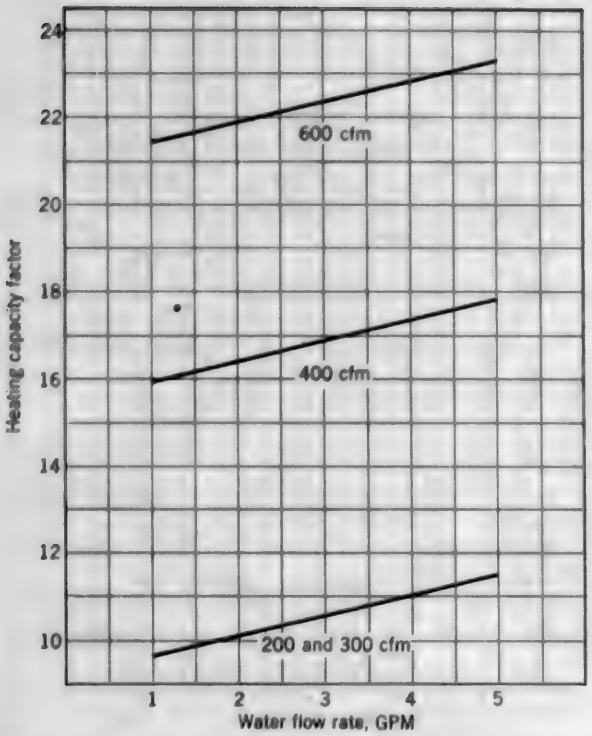



Fig. 9. Heating capacity factors for units with the fans not running.

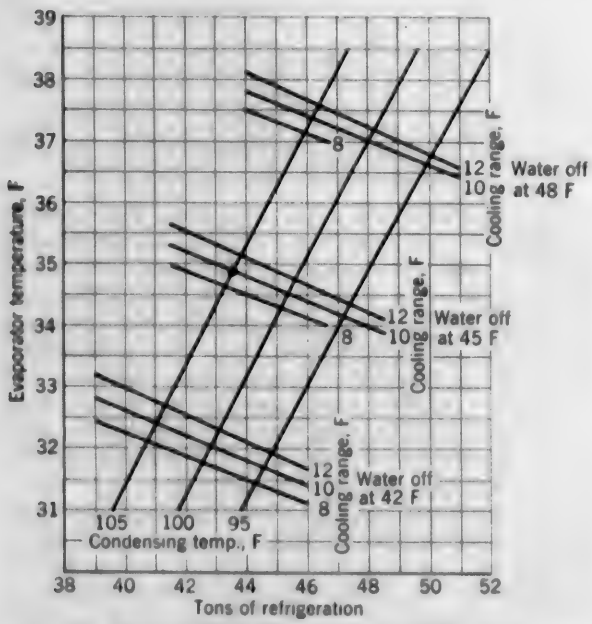



Fig. 10. Performance curves of a packaged water chiller using F-22.

## Good Practice

In connection with the use of heating and cooling systems, there are a few basic and important factors that are considered good practice for all jobs.

1. The supply and return piping to the individual room units from the central plant system must be carefully insulated to prevent rapid heat exchange with the surrounding air and also to prevent condensation of moisture on the piping with resulting damage to the structure. This necessitates the use of a vapor seal on the outside of the insulation so that moisture cannot penetrate.
2. Care must be taken in the use of these systems to provide regular cleaning of the filters so that there is no interference with the normal supply of air flow from the units. Motors must be oiled at regular intervals in accordance with the motor manufacturers' recommendations.
3. Systems of this type using a wall aperture arrangement for outside air must be protected in some manner so that freezing temperature air does not come in contact with the water coil during the off-cycle of the equipment.
4. In designing these systems, it is good practice to maintain a constant water temperature on cooling, but on heating the water temperature may be varied to suit outside conditions.
5. It is important in the use of a system of this type that proper instructions be provided to the room occupant so he understands the general arrangement

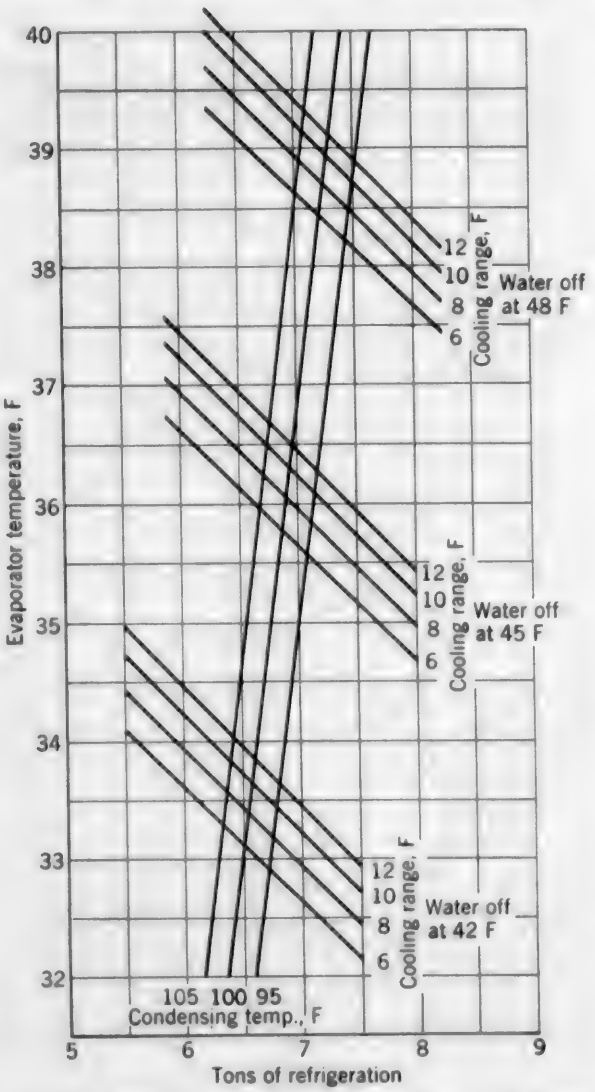



Fig. 11. Performance curves of a packaged water chiller using F-12.

of the system, its intended use, and what he can do to regulate the temperature.

### Basic Systems

In general there are four or five basic systems where these units are commonly used. Some advantages of the wall aperture system are: it requires no duct work, it provides individual unit control, it conditions both outside and room air in all seasons, eliminates transmission of noise or odor between rooms, the same piping circuit supplies chilled water in summer and hot water in winter, and also, it is practical for small and medium sized multi-room buildings

Another system which is quite common in the northern localities where they have cold water temperature is the well water system, Fig. 2D. Cold well water is run through the units in the summer time to provide cooling. In the winter time the system is rearranged with a closed circuit for hot water heating in the normal manner. Some of the advantages of this system are:

1. Initial cost is lower.
2. Operating cost is lower.
3. Well water can be utilized for other purposes after use in the cooling units.

In certain types of existing structures the modernization system shown in Fig. 2C has numerous advantages. In this type of system, air conditioning is done say on the basis of five rooms per floor the height of the building. This is a feasible plan with a common wet column arrangement. The vertical risers feed the five room units per floor from horizontal runouts. The central plant equipment can be conveniently located in the attic space or in the basement, whichever space is available.

A very common system in new buildings is the interior ventilation system. Here the fan coil type unit is placed on the periphery of the building and conditions a space approximately 20 ft from the outside wall. The interior of the building is conditioned by an interior ventilation system. This interior system also supplies outside air to the exterior zone. This system has many advantages:

1. Temperature and humidity of ventilation air can be properly controlled in all seasons.
2. Eliminates stack effect in tall buildings.
3. One hundred per cent outside air can be used in the interior system during certain seasons.
4. Smaller ductwork required than for central station duct system.

Another type of system is the split coil system, Fig. 2B. With this arrangement there are two coils in each fan coil unit. The cooling coil is usually three rows deep and the heating coil one row deep. The heating coil is on the leaving air side of the cooling coil. This makes it possible to quickly shift individual units from heating to cooling, depending upon individual room requirements. It also provides the means of reheat with proper control for controlling humidity during the in-between seasons.

As outlined, liquid systems of heating and cooling are a trend in the air conditioning business for multi-room structures. They are particularly important in a quality air conditioning job because they provide individual control to suit personalized comfort requirements and they are located on the periphery of the building where the variable loads are largest.

---

## Air Conditioning Improves Health of Animals

Air conditioning is a necessity for the raising and breeding of animals and poultry. Carrier Corp. cites a number of cases where air conditioning has solved problems dealing with animals and poultry.

Pug dogs, for example, due to the construction of their pug noses, have respiratory trouble which leads to heat exhaustion in the summer. A man in the Middle West decided to go all out for prize-winning pugs and built an air conditioned kennel. He won many blue ribbons as a result.

Cows, it is said, produce the most milk when the temperature is between 50 and 60 deg F. Pigs put on more pounds when the temperature is kept between 60 and 75 deg throughout the year, fewer pigs are lost at birth, and they grow faster while consuming less feed.

Chickens and other poultry—third-ranking farm income producer—present one of the biggest challenges to scientists seeking ways to obtain maximum profits at lowest cost. Like humans, chickens function at their peak efficiency when the surrounding atmospheric conditions are favorable. For the feathered species, peak efficiency means laying more and better eggs, and they do it when the temperature is between 60 and 80 deg.

Fancy hen coops are now built with complete insulation, double-glazed windows, concrete floors constructed well above ground level, proper orientation of the house to receive maximum benefits from solar radiation, and a roof overhang on the southern exposure as an aid to summer cooling.

Other animals than those living down on the farm are also enjoying the benefits of air conditioning. An owner of greyhounds in Boston bought a room air conditioner for his canine streaks of lightning to keep them from panting too hard between races.

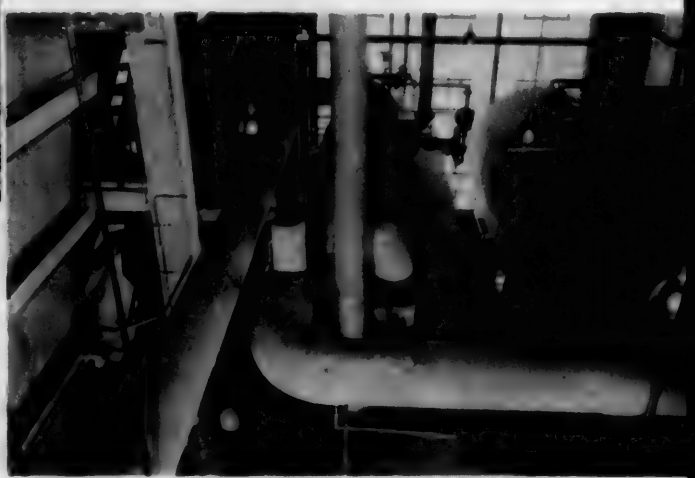
One of the most dramatic and productive occurrences involving air conditioning's contribution to the welfare of dumb animals happened on the high seas. A group of 104 purebred Brahman cows was to be shipped from Florida to Costa Rica to improve the herd of a Central American cattleman. During the month of July when they were to be transported, the Caribbean climate plus the respiratory heat of the blue-blooded bovines would have produced temperatures in the below-deck cattle quarters running as high as 120 deg.

It is not unusual to lose from 10 to 15 head during such a trip. But not so with this expedition. Space was hired in an air conditioned fruit transport where 75 deg were maintained. When the ship reached Port Limon, Costa Rica, the cows not only had to be driven from their comfortable quarters to the scorching deck, but a count of noses showed that their number had increased to 105 in transit.

# High Temperature Water

## serves spread-out, $4 million heating system at McGuire Air Force Base in New Jersey

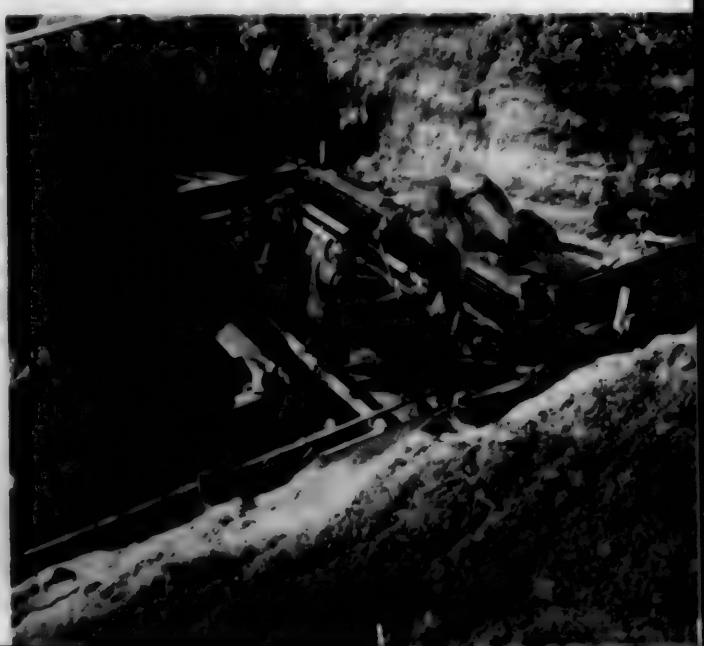
Unique boiler house at the McGuire Air Force base at Wrightstown, N. J., houses four boilers with capacity to generate 7,200 gpm of 420 deg F water which is circulated through 33 miles of underground piping to about 75 heat transfer stations serving dispersed barracks, messhalls and other buildings. Coal is stored on adjacent concrete slab. System was erected and installed by Charles Simkin and Sons, Inc., for the U. S. Army Corps of Engineers. Equipment includes high capacity coal and ash handling machinery. Flyash collectors are on boiler house roof.



(Above) Two 30-ton expansion drums—each holds about 15,000 gallons of reserve high temperature water—are connected in parallel by mains in the foreground. Drums carry operating pressure of 300 psi.

(Below) Three of six circulating pumps which propel return water through boilers. Each pump is powered by a 40 hp motor. As with every electrically actuated process in the McGuire Air Force Base boiler house, control over this phase can be exercised by a single technician stationed at the main instrument panel.

(Below) Provisions for expansion were made by cold-stretching loops prior to weldment and insulating curved lengths with a lean concrete-vermiculite mix. Hydrostatic testing was at pressure of 500 psi.



AIR CONDITIONING, HEATING AND VENTILATING'S
Reference Section

# 16 examples and solutions to Energy Equations for Flow and Nonflow Systems

F. W. HUTCHINSON

Professor of Mechanical Engineering, University of California, Berkeley, Calif.

AIR CONDITIONING, HEATING AND VENTILATING — JUNE, 1955

# 16 examples and solutions to Energy Equations for Flow and Nonflow Systems

F. W. HUTCHINSON

Professor of Mechanical Engineering, University of California, Berkeley, Calif.

**Air conditioning, heating, ventilating and refrigeration systems all deal with the liberation, transportation, and transformation of energy. Whether working with a heating coil, a boiler, or an air washer the engineer is primarily concerned with the rate and quantity of energy which is being transferred from place to place or transformed from a less useful to a more useful form. Thus energy is the stock in trade of the engineer and energy equations are the tools which assist in utilizing energy to maximum advantage. The present Reference Section provides a comprehensive review of the energy equations for practical systems involving nonflow (as heating or mixing within a closed tank), flow (as in air or refrigeration compressors), and flow to nonflow (as from pipeline to receiver). A major feature of the Reference Section is the inclusion of sixteen numerical examples chosen to illustrate the direct application of the energy equations to typical actual systems.**

THE laws of conservation of mass and energy provide qualitative information concerning the conditions which must exist in any heat-power system or during any thermal process. In order for these laws to provide quantitative assistance, however, they must be used to formulate equations relating the inflow, outflow, and accumulation (or diminution) of energy in such systems and during such processes. Energy equations are mathematical statements which provide an accounting of the various mass-quantities and energy-quantities which are important in heat-power operations. All energy equations are explicit statements of the first law of thermodynamics (which states that energy can neither be created nor destroyed) and the information which they provide is equivalent to, but not greater than, the information implicit in that law.

An energy equation establishes quantitative relationships among the several forms of energy which may act in or on a system, but it gives no information whatsoever as to the probability, or even the possibility, that the indicated action will occur. Energy equations can be written for any system irrespective of how practicable or impracticable it may be; the equation merely states what will happen in such a system *if* something does happen. Thus one can write

$$\text{Work in} = \text{Heat out} \qquad (1)$$
$$A\text{Wk}_{in} = Q_{out}$$

where $A$ equals 1/778 and converts work, $Wk$ in foot-pounds to Btu, and $Q$ is energy in Btu.

This is an energy equation stating that if the only supply of energy to a system is as work and if the only dissipation of energy from the system is as heat the entire input of work will necessarily leave in the form of heat. Figure 1 illustrates a system for which equation 1 applies: Shaft work is supplied through a blender or mixer to a tank full of some fluid; cooling water carries thermal energy from the tank at a rate such that the temperature of the material in the tank remains constant. All of the work supplied through the propeller shaft is dissipated as friction within the fluid and is removed unit-for-unit as heat flow to the cooling water. Experience tells us that a system of this kind is quite practicable and could be established without difficulty.

Consider, now, that equation 1 be rewritten in reverse to describe a system in which energy flows as heat to a tank full of material and is then transformed to work, leaving through a propeller shaft; the equation with units as before, is

$$\text{Heat in} = \text{Work out} \qquad (2)$$
$$Q_{in} = A\text{Wk}_{out}$$

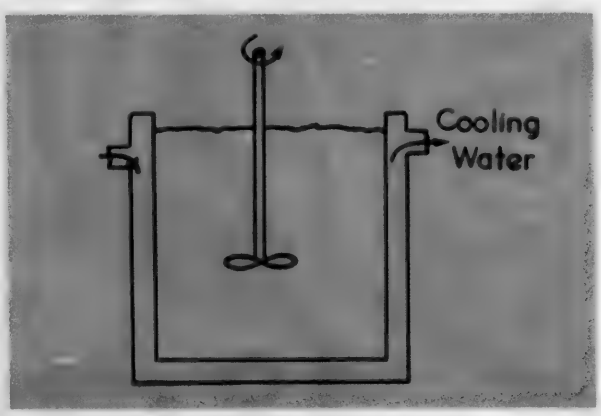



Fig. 1. Dissipation of work as heat loss.

which is a correct statement of the quantitative relationship required by the first law, but which visualizes a situation that, from common experience alone, is untenable. We know that a propeller submerged in water will not automatically turn and deliver work back through the shaft as a result of transforming thermal energy to mechanical energy. Equation 2 is thus a correct statement of what would happen *if* something happened, but it describes a situation in which nothing could conceivably happen.

As an even more forceful example, visualize a hot object in contact with a cold object and write an energy equation in the form

$$\triangle U_{\text{leaving cold}} = \triangle U_{\text{entering hot}} \qquad (3)$$

where $U$ is thermally stored internal energy.

This says that any loss of internal energy from the cold body will be equalled by a gain of internal energy by the hot body. But here again common experience tells us that when a hot body and a cold body are placed in contact, internal energy will flow from hot to cold rather than—as stated by the equation—from cold to hot. Again, however, the validity of the equation is not in question, since it merely tells how the energy quantities would be related *if* the indicated transfer were to occur.

From a different standpoint an energy equation is an expression of the impossibility of achieving perpetual motion of the first class; that is, continuous dissipation from a machine of *more* energy than is supplied to it. Energy equations do not, however, assist in evaluating the performance of a system in terms of perpetual motion of the second class; that is, continuous dissipation from a machine of shaft work in amount *equal* to the thermal energy supplied to it.

# Part 1
# Energy Equations for Nonflow Systems

A nonflow system is one in which no mass transfer takes place. The system contains a given amount of working substance and this fluid flows from place-to-place within the boundaries, but there is no transfer of mass in or out across the boundaries of the system. This definition leaves room for consideration of three different classes of heat-power systems (refer Fig. 2) which meet the conditions of nonflow:

Class 1. A closed container with fixed boundaries, as a tank in which heating, cooling, or mechanical mixing may take place.

Class 2. A closed container with movable boundaries, as an engine cylinder during the periods in which all valves are closed and the fixed weight of material within the cylinder is acting on the piston (or being acted on) to bring about a change in cylinder volume.

Class 3. *Any* heat-power system for which the established boundaries are outside the circuit in which the working substance flows. Thus the line establishing the "boundary" of a steam power plant could be drawn around the power house; in this case—for a condensing plant—the working substance would never cross the boundary, hence the system would be one of nonflow, though thermal energy would be admitted in the fuel (stored in chemical form) and shaft work (or electricity) would be discharged across the boundary together with the heat dissipated to the cooling water.

A second method of classifying nonflow systems is with respect to time. Systems which come under the second of the three headings listed above are always of a transient nature since it is evident that physical limitations on size of cylinder and on movement of piston require that any process of expansion or compression necessarily reach a limit; analysis of nonflow systems of this second category is therefore limited to a single process, and must take account of a change of state with time. Nonflow systems of the first or the third category can be either transient or steady state. Thus, if energy flows from a tank, as heat, at a rate equal to that of energy reception as shaft work (refer again to the mixing example of Fig. 1), the fluid within the tank will not undergo a state change, whereas, if the tank is heated without extraction of energy at equal rate, the internal energy of the stored material will rise and a transient condition will necessarily exist. For systems of the third type steady state will be the normal condition for operation at fixed load, but during start up, load change, or shutdown the situation will be one corresponding to transcience.

*Example 1:* A class 3 nonflow system consists of a building around which an arbitrary boundary is established. A 200-pound man enters an elevator at the ground floor and is carried up 100 feet after which the elevator returns to the ground floor. The total electrical energy supplied to operate the elevator amounts to the equivalent

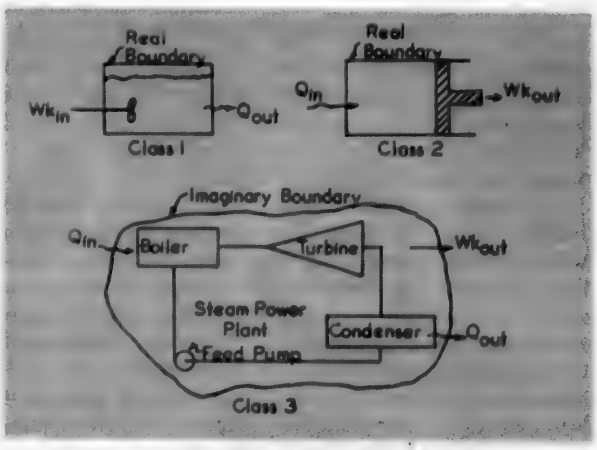



Fig. 2. The three classes of nonflow heat-power systems.
Class 1. Closed container: fixed boundaries (steady or transient).
Class 2. Closed container; movable boundaries (transient only).
Class 3. Closed system: imaginary (arbitrary) boundaries (steady or transient, but usually steady).

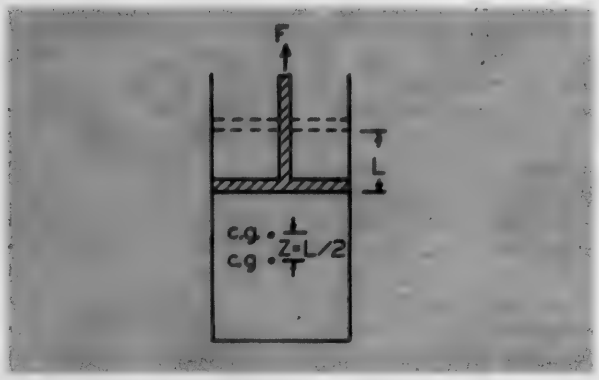



Fig. 3. Cylinder and piston forming a movable boundary system.

of 70,000 ft-lb. Establish an energy equation for this system and determine the method of dissipation of the energy supplied to the elevator.

*Solution:* This is a transient system in which the energy which enters as work is first partially converted into external potential energy in raising the man and the elevator. The elevator then returns to its initial elevation so all of the energy originally supplied, except that stored in external potential form in the man, is finally dissipated as heat due to friction and due to braking the elevator's descent. The energy equation is therefore

$$Wk_{in} = w_{man}z + 778Q_{out}$$

where $w$ equals weight in pounds and $z$ is elevation in feet.

$$70{,}000 = (200)\ (100) + 778Q_{out}$$
$$Q_{out} = 50{,}000/778 = 64.2 \text{ Btu}$$

(The 20,000 ft-lb stored in the man will likewise be dissipated as heat from elevator brakes when he comes down.)

### Steady State Nonflow Systems

For systems of this type (whether of the first or the third class) there is neither accumulation nor diminution of energy within the boundaries. Thus the energy equation can include only terms for energy in transition and in its most general form would be

$$Q_{in} + AWk_{in} = Q_{out} + AWk_{out} \qquad (4)$$

where the $Q$ term is considered to include any form of non-mechanical energy (as chemical) that crosses the boundaries of the system and the $AWk$ term is considered to include the mechanical equivalent of any electrical energy that enters or leaves the system.

As applied to a steam power plant equation 4 would include in $Q_{in}$ the chemical energy entering the system with the fuel and released during the process of combustion. The term for work in, $AWk_{in}$, would take account of energy supplied to the feedwater pump and to other auxiliaries. The $Q_{out}$ term would be largely made up of thermal energy discharged in the condenser to the cooling water, but it would also take account of such heat losses as might occur from the boiler or from other equipments which are included within the system. The $AWk_{out}$ term would equal the energy leaving the turbine or steam engine or (if generator losses were included in $Q_{out}$) it could be the equivalent of the electrical output of the generator.

*Example 2:* A steam power plant delivers 1,000 hp as shaft work while dissipating 10,000,000 Btu per hr in the condenser and as heat losses from the various equipments. Determine the efficiency of conversion of thermal energy to shaft work.

*Solution:* This is a class 3 nonflow system for which the energy equation, written for the plant as a whole is

$$Q_{in} = Q_{out} + AWk_{out}$$
$$Q_{in} = 10{,}000{,}000 + (1000)\ (2545) =$$
$$12{,}545{,}000 \text{ Btu per hr}$$

The efficiency of the system (based on thermal energy received by the boiler) is, therefore

$$e = 2{,}545{,}000/12{,}545{,}000 = 0.2 \text{ or } 20\%$$

(The true thermal efficiency, as used in practice, would be lower than the above value as it would be based on the energy that would be released from the fuel when burned under conditions of complete combustion.)

When applied to a compression-type refrigeration system, equation 4 simplifies to the form

$$Q_{evaporator} + AWk_{compressor} = Q_{condenser} + Q_{compressor} \qquad (5)$$

which indicates that the capacity of the condenser must exceed that of the evaporator by an amount equal to the net energy input to the compressor. For refrigeration systems in which the compressor operates without appreciable cooling

$$Q_{condenser} = AWk_{compressor} + Q_{evaporator} \qquad (6)$$

which shows that the energy required to operate a refrigeration compressor is costly not only when purchased as shaft work (or electricity) but also when disposed of to purchased cooling water.

### Transient Nonflow Systems

The general form of the energy equation as applied to nonflow systems in which there is an accumulation—or diminution—of energy within the system is

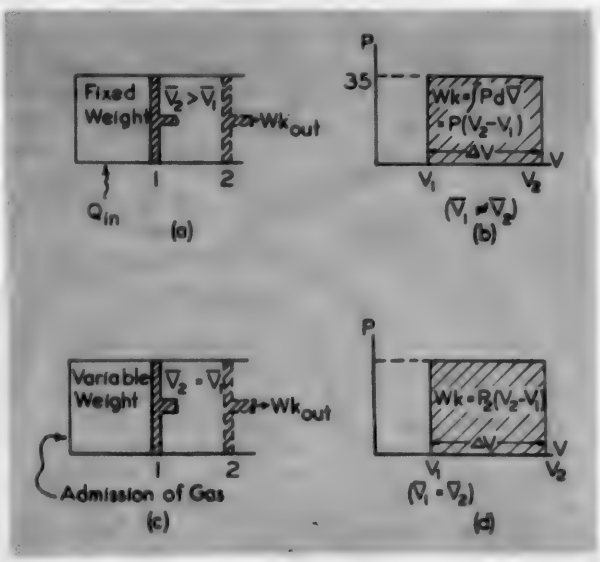



Fig. 4. Isopiestic expansion (nonflow) versus Isopiestic admission (flow).

$$Q_{in} + AWk_{in} = \triangle U + Q_{out} + AWk_{out} \quad (7)$$

where $\triangle U$ represents an *increase* of the internal energy possessed by the total weight of working substance contained within the system; if $\triangle U$ should be negative, it would obviously mean that internal energy had left—rather than entered—storage in the working substance. In by far the greater number of cases work either enters or leaves, but does not both enter and leave, the working substance, hence equation 7 can be simplified by writing both the work and the heat term for net inward transfer; thus

$$Q_{in} + AWk_{in} = \triangle U \quad (8)$$

which says that any net transfer of energy into the system must appear as a rise in the internal energy of the contained working substance. The work entering the system can either be dissipated as friction with a consequent rise of fluid temperature (unless equivalent energy is extracted as heat) or can be used to compress the working substance with a resultant rise of internal energy. The difference between these two possible usages of work corresponds to the difference between a nonflow system with fixed boundary (class 1) and a nonflow system with movable boundary (class 2):

*(1) Fixed boundary system.* The process followed in any system of this kind—by definition of the boundary condition—is one of constant volume. But the work done on or by a working substance during such a process must be zero; if work were supplied to the system, it would have to be dissipated entirely as thermal energy resulting from internal friction.

*Example 3:* A closed tank contains 1,000 pounds of a chemical having specific heat at constant volume, $c_v$, of 0.4. The chemical is to be heated from 40F to 45F in a period of 1½ hours during which time it is to be continuously mixed by means of a mechanical agitator with a 0.2 horsepower energy output. Neglecting volume change and assuming that there are no heat losses, determine whether heat must be added to or removed from the chemical in order to achieve the desired temperature rise. Determine the quantity of heat to be added or removed.

*Solution:* This is a transient nonflow system to which equation 8 can be applied, with $U$ expressed as $u$ in Btu per pound.

$$\begin{aligned} Q_{in} + AWk_{in} = w(\triangle u) &= wc_v(t_2 - t_1) \\ Q_{in} + (1.5)(2545)(0.2) &= (1000)(0.4)(5) \\ Q_{in} + 763.5 &= 2000 \\ Q_{in} &= 1236.5 \end{aligned}$$

Thus 38% of the required heating effect is provided by energy dissipated by the stirring equipment.

*(2) Movable boundary system.* Consider a cylinder fitted with a frictionless piston (Fig. 3) as the boundary of this type of system. An infinite number of processes are possible depending only on the way in which the force acting exterior to the piston is varied as a function of piston position. Work supplied to the cylinder will either compress the working substance or be dissipated through fluid friction as internal energy; in most actual cases some of the entering work will be dissipated in each of these two ways. If the fluid is allowed to expand, work will be delivered to the shaft (hence leave the system), the work quantity—for a frictionless process—being given by the usual term* $\int PdV$.

The general nonflow equation for a movable boundary system is

$$Q_{in} + AWk_{in} = \triangle U + Aw\triangle z \quad (9)$$

where $w$ is the weight of material within the system and $\triangle z$ is the increase in vertical height of the center of gravity of this material following completion of the process; for a horizontal cylinder the vertical position of the center of gravity does not change, hence, for such a case, the $\triangle z$ term drops out. Even for vertical cylinders, however, the magnitude of $Aw\triangle z$ will almost always be negligibly small as compared with the heat, work, and internal energy terms; in the analyses which follow this assumption of negligibility of potential energy storage will be made.

Although there are an infinite number of possible processes for the movable boundary system, convenience of analysis and practicability of mechanical design usually limit the number of commonly used processes to those which involve constancy of some one fluid property. The most common processes are those of constant pressure and of constant temperature, but constancy of either enthalpy (defined as h, the sum of internal energy, $u$, and of the $AP\overline{V}$ product where $A$ is as before, $P$ is pressure in pounds per square foot and $\overline{V}$ is specific volume in cubic feet per pound) or internal energy is also of sufficient interest to justify attention. Generalized processes in which the expansion or compression follows a polytropic ($PV^n$ = constant, where $n$ is the polytropic exponent) are also of importance, particularly a polytropic occurring without friction and without transfer of heat to or from the working substance; this latter process—defined as an isentropic—is of major importance as it closely resembles the actual expansion process followed in many heat-power equipments. The various common processes will now be considered in detail:

(a) *Constant pressure (isopiestic) nonflow expansion process.* Assuming no friction losses the energy equation for this process takes the form (10)

$$\begin{aligned} Q_{in} &= Aw\int Pd\overline{V} + \triangle U = AP(V_2 - V_1) + \triangle U \\ &= w[(u_2 + AP\overline{V}_2) - (u_1 + AP\overline{V}_1)] \\ &= w(h_2 - h_1) \end{aligned}$$

But (except during phase change)

$$Q_{in} = wc_p(t_2 - t_1) \quad (11)$$

(where $c_p$ is specific heat at constant pressure)
Hence

$$\triangle h_{gain} = c_p\triangle t \quad (12)$$

*Example 4:* One pound of air at 35 psia is confined within a cylinder. As heat is added the air undergoes a constant pressure expansion which raises its temperature from 100F to 200F. Determine the volume change and the amount of work delivered to the piston during the expansion and compare the system with one in which an equal volume change is brought about through the admission of an additional quantity of air (at the initial state) to the cylinder.

*Refer to "Work—A Discussion of its Engineering Significance," F. W. Hutchinson, Heating and Ventilating, December, 1954.

*Solution:* Figure 4a shows the cylinder with the piston at an initial position 1 from which it moves right to position 2 as the air, through reception of heat, undergoes an isopiestic expansion. Figure 4b shows the corresponding pressure-volume diagram for the system. The energy equation for this transient nonflow process is obtained by equating the heat added to the sum of work done plus internal energy increase; since the working substance is a perfect gas (no internal potential energy) we can write the equation in the form

$$Q_{in} = AP(V_2 - V_1) + wc_v(t_2 - t_1) = wc_p(t_2 - t_1)$$

The volume change is therefore

$$\begin{aligned}(V_2 - V_1) &= w(c_p - c_v)(t_2 - t_1)\,778/(35)(144)\\ &= 1(0.24 - 0.17)(100)\,778/(35)(144)\\ &= 5446/5040 = 1.08 \text{ cu ft}\end{aligned}$$

The work delivered during the expansion is the $AP\triangle V$ product and, from the solution, is equal to 5446 ft lb. Note that, for *any* perfect gas process, the work is the product of weight of gas times temperature change times difference between the specific heat for the process and the specific heat for a constant volume process.

In contrast with the system of the above example, Fig. 4c and 4d show the cylinder arrangement and the "equivalent" pressure-volume diagram for a *flow* system in which the same volume change occurs due to admission rather than expansion. In this case the work delivered to the piston is exactly the same in amount as for the expansion, $Wk = P(V_2 - V_1)$, but there is no state change of the working substance and the energy which leaves as work must therefore be delivered with the entering fluid in the form of associated flow work.

(b) *Constant temperature (isothermal) nonflow expansion process.* Assuming no friction losses the energy equation for this process is

$$Q_{in} = AWk_{out} + \triangle U \qquad (13)$$

where $\triangle U$, if it exists, must consist entirely of an increase in the potential fraction of internal energy; (since the temperature does not change, there cannot be any change in the kinetic fraction of internal energy possessed by the working substance). When the working substance is a perfect gas, it does not possess any internal potential energy, hence for such cases equation 13 reduces to the form

$$Q_{in} = AWk_{out} \qquad (14)$$

which indicates that the isothermal expansion of a perfect gas permits complete conversion of entering thermal energy to shaft work. Needless to say the condition expressed by equation 14 is a most satisfactory one, but its practical value is severely limited by the fact that it is only applicable to process rather than a cycle; in order to utilize the conversion indicated by equation 14 in any real equipment means must be found for restoring the working substance to its original state, hence of permitting cyclical operation. Subsequent investigation will show that the restoring processes cannot be carried out with high thermal effectiveness, hence the unit-for-unit energy conversion implied in equation 14 cannot be accomplished under conditions of continuous operation. If the isothermal expansion process could occur continuously, it would represent perpetual motion of the second class (*complete and continuous* conversion of heat to work). As a single process, however, the reversible isothermal, using a perfect gas as a working substance, represents the ultimate in thermodynamic effectiveness.

*Example 5:* Determine the shaft work required to isothermally compress 20 cubic feet of air to 3 atmospheres.

*Solution:* The polytropic exponent for isothermal compression of air can be taken as unity. Therefore

$$P_1V_1 = PV$$

or

$$P = (P_1V_1)/V$$

The work of the compression process is

$$\begin{aligned}Wk &= \int PdV = P_1V_1 \int dV/V\\ &= P_1V_1 \ln V_2/V_1\\ &= P_1V_1 \ln(P_1/P_2) - P_1V_1 \ln(P_2/P_1)\\ &= -(14.7)(144)(20)\ln(3)\\ &= -46{,}500 \text{ ft lb, or approximately 60 Btu}\end{aligned}$$

*Example 6:* For the conditions of the preceding example assume that an amount of energy equal to that needed for the isothermal compression were used instead to heat the air at constant volume. Determine the resultant temperature rise of the air.

*Solution:* The specific volume of atmospheric air at 70F is approximately 13.5 cu ft per lb so the weight of air involved in the compression of the preceding example is approximately $20/13.5 = 1.48$ lb. The temperature rise during constant volume heating of this weight of air would be

$$\triangle t = Q/(wc_v) = (60/1.48)\ (0.17) = 238 \text{ F}$$

(c) *Polytropic nonflow expansion process.* The energy equation for a process of this kind is

$$Q_{in} = \triangle U + A(P_2V_2 - P_1V_1)/(n - 1) \qquad (15)$$

where the value of n, and hence the work-heat relationship, depends on the conditions of the particular process.

(d) *Reversible adiabatic (isentropic) nonflow expansion process.* In this type of process there is no heat flow to-or-from the working substance, hence the energy equation becomes,

$$\triangle U_{loss} = AWk_{out} = A(P_2V_2 - P_1V_1)/(n - 1) \qquad (16)$$

where the polytropic exponent, $n$, now assumes the value corresponding to isentropic expansion ($n = c_p/c_v$) and the total work output is realized as a transformation of thermal energy stored within the working substance. As with the isothermal, the isentropic process is attractive in that it affords complete conversion of thermal energy to work, but its application in practice is not equally rewarding because the other processes which must be used to replenish the supply of internal energy (and thereby permit continuous operation of the system) are accompanied by unavoidable losses which greatly reduce the overall effectiveness of the system.

*Example 7:* For the conditions of example 5 determine: (a). The work required to compress the air if the process is isentropic; (b). The work required to compress the air through the same compression ratio, $(V_1/V_2)$, as for isothermal, but with an isentropic process.

*Solution:* (a). Taking the polytropic exponent for isentropic compression of air as 1.4,

$$V_2 = V_1 (P_1/P_2)^{1/n} = 20(1/3)^{1/1.4} = 9.13$$

hence

$$Wk = [(P_2V_2 - P_1V_1)] (n - 1) = (14.7) (144) [(3) (9.13) - (1) (20)] \div (1.4 - 1)$$

39,360 ft lb, or approximately 50 Btu.

(b). For isentropic compression through the same compression ratio as isothermal compression the required compression ratio (from example 5) is 20/6.67, hence the final pressure is determinable as

$$P_2 = P_1 (V_1/V_2)^n = 1(20/6.67)^{1.4} = 4.44$$

The work requirement of this isentropic process would then be

$$Wk = (14.7) (144) [(4.44) (6.67) - (1) (20)] \div (1.4 - 1)$$

= 50,800 ft lb or approximately 65 Btu

### Limitations of Nonflow Analyses

The principal application of nonflow methods of analysis is with respect to steady state conditions in large systems. In such cases the nonflow equations permit obtaining a rapid and simple visualization of the overall energy characteristics of the system without need of investigating the details of such processes as may occur internally. The nonflow equations for steady state deal entirely with conditions at the boundaries of the system and neither the processes, nor equipments, nor working substances which are within those boundaries have any influence on the overall energy exchanges.

As applied to transient systems the nonflow analysis is of very limited practical value, since, as previously discussed, it deals only with a single process, whereas practical significance of any heat-power system invariably depends on a combination of processes so related that they constitute a cycle, hence permit treatment of the system under conditions of continuous reception and delivery of energy. In dealing with actual systems the nonflow equations are established for each of the successive individual processes which make up the cycle and the combined result indicates overall performance.

## Part 2
## Energy Equations for Flow Systems

In its most general form a heat-power system involves flow of both mass and energy with possibility of storage (or extraction from storage) of both mass and energy from the material within the system. There may be one or many fluids passing through the system and energy to-or-from storage may be with respect to one or many materials contained within the boundaries of the system. Flow may be continuous, intermittent, or oscillating, and the flow either to or from the system may become zero. In the latter case, if flow occurs from, but not to, the system, the analysis becomes one of establishing energy equations for a case of nonflow to flow, whereas if flow occurs to, but not from, the system, the analysis becomes one of establishing energy equations for flow to nonflow. In many cases steady flow of mass occurs while at the same time the energy flow is under transient conditions (as during the interval of warming up an engine or of changing load).

Irrespective of the type of system under consideration one major difference always exists between an energy equation which takes account of flow and an energy equation which is established (as in Part 1) for a nonflow process: When flow exists each term of the energy equation always expresses a *rate* of energy transfer, whereas for a nonflow system each term of the energy equation expresses a *quantity* of energy. Energy equations written for generalized flow systems are applicable only at one particular instant (though if time is not a variable—that is, if conditions of steady state exist—the equation will be equally applicable at other times).

### Flow Conditions

Fortunately for the engineer, all practical heat-power flow systems have certain characteristics in common which permit substantial reduction in the degree of generality required of the energy equations. Since a primary objective of most heat or power equipments is to obtain continuous transformation of energy from one form to another, it follows that even such intermittently-operating units as a reciprocating compressor will necessarily be run at sufficiently high speed to permit treating them as though the operation were continuous. Thus at a short distance upstream or downstream from such a piece of apparatus the flow will be continuous, unidirectional, and—except during conditions of changing load—steady. Further, flow to-or-from equipments is always in closed conduits filled entirely with the working fluid; free surface effects do not enter into the analysis and pressure difference due to hydrostatic effect is always so slight as to be negligible.

In some cases the working fluid may undergo compression or expansion under flow conditions, but in the greater number of equipments processes involving compressibility occur (other than due to line friction) only in nozzles, cylinders or other special pieces of equipment. Basically, however, there is no thermodynamic difference between a system in which expansion and steady flow are segregated (as in a steam engine) and systems in which these two processes occur superimposed (as in the reaction blades of a steam turbine).

### The General Energy Equation

As written for heat-power purposes the most general form of a flow equation includes terms for the transition, transformation, and storage of energy. For heat-power application, chemical and atomic forms of stored energy usually are not included in the accounting, and energy in transition by mechanisms other than heat or work is

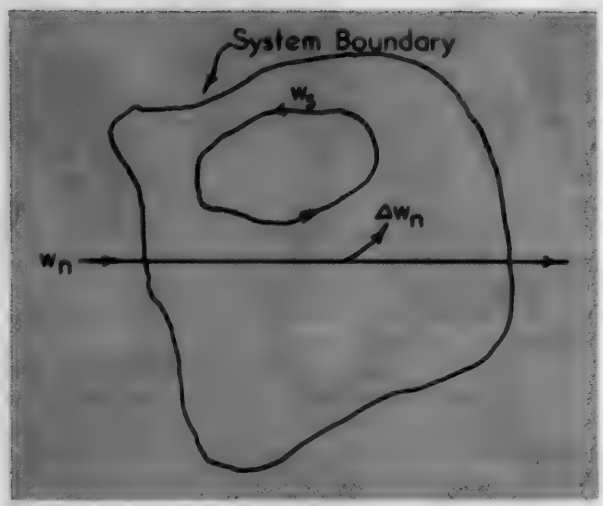



Fig. 5. Idealization of a system for generalized general energy equation.

$w_s$ = One of s streams of fluid each of which is of fixed mass, but variable energy content.

$w_n$ = One of n streams of fluid each of which may supply (or take away) either or both mass and energy.

likewise not accounted for. In qualitative terms the general energy equation for a flow system—including storage—takes the form,

(Energy transferred into the system) + (Energy transported into the system) = (Energy transferred out of the system) + (Energy transported out of the system) + (Energy entering storage in the system) (17)

The parenthetical term for energy transfer includes three separate forms of energy:

(1) Energy transferred in or out as heat, indicated by $q$ in units of Btu per hr.

(2) Energy transferred in or out as work, indicated by $Wk'$ in units of ft lb per hr, or by $AWk'$ in units of Btu per hr. Note that the symbol $Wk'$ is used to represent *rate* of doing work (hence power) in contrast to the unprimed symbol, $Wk$, which is work quantity.

(3) Energy transferred in or out as flow work, indicated by $\Sigma_{nwn}AP\overline{V}$ where $w$ is a flow rate in pounds per hour, $P$ is pressure in pounds per square foot absolute, $\overline{V}$ is specific volume in cu ft per lb, and the summation is indicated for each of the $n$ streams of fluid which may be passing through the equipment; the units are Btu per hr.

A quantitative statement of the terms for energy transfer is then of the form,

$$(\text{Energy transferred})_{\text{in-or-out}} = (q + AWk' + \Sigma_n w_n AP\overline{V})_{\text{in-or-out}}$$

The parenthetical term for energy tranpsortation includes the summation for each of the mass streams passing through the equipment of energies stored in potential, internal, and kinetic form,

$$(\text{Energy transported})_{\text{in-or-out}} = \Sigma_n w_n (Az + u) + Av^2/2g_{\text{in-or-out}}$$

where $v$ is velocity.

The parenthetical term for energy to storage includes the summation for each of the masses within the system of increases in the three forms of stored energy and it also includes a summation of energy associated with such additional masses as may be entering and remaining with the system,

$$(\text{Energy to storage}) = \Sigma_s w_s \triangle(Az + u + Av^2/2g) + \Sigma_n \triangle w_n (Az + u + AP\overline{V} + Av^2/2g)$$

where $w_s$ is the weight of any one of the s materials which may be within the system and $\triangle w_n$ is the *rate* at which mass from each stream of the $n$ streams is *entering storage*. Note that fluid entering storage dissipates its associated flow work.

Substituting for each of the parenthetical terms of equation 17 gives the general energy equation in its most complete form,

$$(q + AWk' + \Sigma_n w_n AP_1\overline{V}_1)_{\text{in}} + \Sigma_n w_n (Az_1 + u_1 + Av_1^2/2g) = (q + AWk' + \Sigma_n w_n AP_2\overline{V}_2)_{\text{out}} + \Sigma_n w_n (Az_2 + u_2 + Av_2^2/2g) + \Sigma_s w_s \triangle (Az_s + u_s (Av_s^2/2g) + \Sigma_n \triangle w_n (Az_1 + u_1 + AP_1\overline{V}_1 + Av_1^2/2g) \quad (18)$$

where subscripts 1 and 2 indicate the values of the particular property at entrance and at exit, respectively, and subscript $s$ identifies materials within the system. Equation 18 is somewhat formidable in appearance, but a thorough understanding of it is absolutely essential; it is the the most generalized form of the energy equation (refer to Fig. 5) and from it can be obtained, by simplification, any of the less complex forms which are applicable to specific arrangements of equipment or particularizations of flow conditions.

The grouping of terms shown in equation 18 is a logical one, since it separates energy in transition from energy in storage. As a matter of algebraic convenience, however, a more satisfactory arrangement is obtained by combining flow work with internal energy (the sum of the two being equal to enthalpy); thus

$$(q + AWk')_{\text{in}} + \Sigma_n w_n (Az_1 + h_1 + Av_1^2/2g) = (q + AWk')_{\text{out}} + \Sigma_n w_n (Az_2 + h_2 + Av_2^2/2g) + \Sigma_s w_s \triangle (Az_s + u_s + AV_s^2/2g) + \Sigma_n \triangle w_n (Az_1 + h_1 + Av_1^2/2g) \quad (19)$$

## Steady Flow Systems

By far the greater number of systems which are important in thermodynamics are characterized by steady and continuous flow of a single working substance through the system. For such cases the storage terms drop out of equation 19, the summations can be eliminated, and the equation simplifies to the form,

$$(q + AWk')_{\text{in}} + w(Az_1 + h_1 + Av_1^2/2g) = (q + AWk')_{\text{out}} + w(Az_2 + h_2 + Av_2^2/2g) \quad (20)$$

Except in such special devices as nozzles which utilize high velocity, the kinetic energy term of the above equation is usually so small with respect to the heat, work, and enthalpy terms that it can be neglected. Thus for flow of a working fluid through piping the velocity is required, through considerations of pressure loss, to be maintained within moderate limits and the thermal equivalent of the kinetic energy stored in the moving fluid is likely to be only a fraction of one per cent of the thermal energy associated with the fluid as enthalpy.

Further, there are not likely to be very great velocity changes between entrance and exit piping, hence no large change in kinetic energy is to be expected.

*Example 8:* Determine that fluid velocity at which the external kinetic energy in storage would equal 1 Btu per pound of fluid.

*Solution:* $Av^2/2g = 1 = v^2/(778)\ (2)\ (32.2)$ giving

$v = 224$ feet per second (or approximately 150 miles per hour)

For systems which operate on a closed cycle, differences in elevation of the working fluid are likely not to be great and even when such distances are of the order of 50 to 100 feet, the thermal equivalent of the change in potential energy is usually so small that it can be neglected. (Thus an elevation change of 77.8 ft would be equivalent to a change of only 0.1 Btu per lb of working substance.) Elevation changes in closed systems are, in any event, not responsible for energy exchanges between the system and its surroundings, since the gain in potential energy of each pound of fluid as it flows to the high point in the system must be exactly equalized by the subsequent loss in potential energy as it returns through the cycle to the low point. Thus for all practical purposes a closed flow system behaves—with respect to its surroundings—exactly as though it were located entirely in a horizontal plane.

Dropping the potential and kinetic terms from equation 20 gives a resultant form of the general energy equation that is applicable to any closed system in which the processes of major importance are of a thermal rather than mechanical order. The equation becomes,

$$(q + AWk')_{in} + wh_1 = (q + AWk')_{out} + wh_2 \qquad (21)$$

When applied to a particular equipment or to some limited part of a closed heat-power cycle, equation 21 can be further simplified by noting that both heat transfer and shaft work usually either enter or leave, but rarely both enter and leave. Thus for an air or refrigeration compressor, shaft work is supplied to the equipment and heat is usually extracted from it, whereas for a steam engine, internal combustion engine, or turbine, there is likely to be a flow of both heat and shaft work from the equipment. For convenience equation 21 can be written in terms of entering energy in transition with recognition of the fact that the sign will change if either heat or work leave the system; thus,

$$q_{in} + AWk'_{in} + wh_1 = wh_2$$

or

$$q_{in} + AWk'_{in} = w(h_2 - h_1) \qquad (22)$$

Equation 22 is the form of the general energy equation that finds widest practical application in connection with analysis of closed systems; in a general sense, the significance of this equation can be visualized by considering its application to the four major types of heat-power equipments:

(1) Equipments which have as their primary purpose the delivery of shaft work.

(2) Equipments which are primarily intended to bring about an increase in pressure of the working fluid as it passes through them.

(3) Equipments which serve primarily to reduce the pressure of the working substance.

(4) Equipments intended primarily as devices for transferring energy, as heat, to or from the working substance.

The above four classifications will now be considered in detail:

*1. Work producing equipments.* As applied to engines, turbines or other pieces of heat-power equipment which are designed to deliver shaft work, the steady flow energy equation (22) takes the form,

$$AWk'_{out} = w(h_1 - h_2) - q_{out} \qquad (23)$$

which states that rate at which work can be delivered by such an apparatus is determined by the enthalpy reduction of the working substance as it passes through and by the rate at which energy is lost as heat. From economic considerations the loss of heat should obviously be kept at a minimum, but in practice structural and metallurgical limitations often require that a steady rate of heat loss be maintained in order to protect the equipment against undesirably high temperatures. Thus the usual internal combustion engine must be cooled—at the expense of work delivery—in order to prevent the mechanical parts from being heated to structurally unacceptable temperatures. Steam engines, on the contrary, are jacketted with steam, or otherwise insulated, to keep heat losses to a minimum.

In many cases the speed of operation and the ineffectiveness of the cooling system (if one is used) is such that there is no appreciable transfer of heat to-or-from the cylinder and the equipment operates isentropically; the energy equation then becomes,

$$AWk'_{out} = w(h_1 - h_2) \qquad (24)$$

which indicates that, for frictionless operation, the loss of enthalpy of the fluid passing through the equipment appears entirely as shaft work.

By comparison of equation 24 with the equations developed in Part I it is evident that, whereas internal energy is the property of major interest in nonflow systems, enthalpy becomes the controlling property as soon as flow becomes continuous. The reason for this difference can be readily recognized by reducing enthalpy to its constituents—internal energy and flow work—and noting that for a flow system the work delivered *by* the entering fluid to the piston is equal to the $AP\bar{V}$ product. Thus $AP_1\bar{V}_1$ is equal to work done by the working substance during the process of constant pressure admission to a cylinder or as a superimposed condition of flow through a turbine, whereas $AP_2\bar{V}_2$ is equal to the work done *on* the fluid by the piston as the fluid is discharged, at constant pressure, from the cylinder or as it flows from the turbine rotor to the discharge line.

Reference to Fig. 6 brings out the difference between flow and nonflow systems in that the area under the expansion curve ab represents work done during the *process* of expansion, and is equal to $\int PdV$, whereas the area to the left of this curve, equal to $\int VdP$, is the net work done on the working substance as a result of the series of processes (a *cycle*) making up admission, expansion, and discharge; thus $\int VdP$ is indicative of the work done during a continuously operating, or flow,

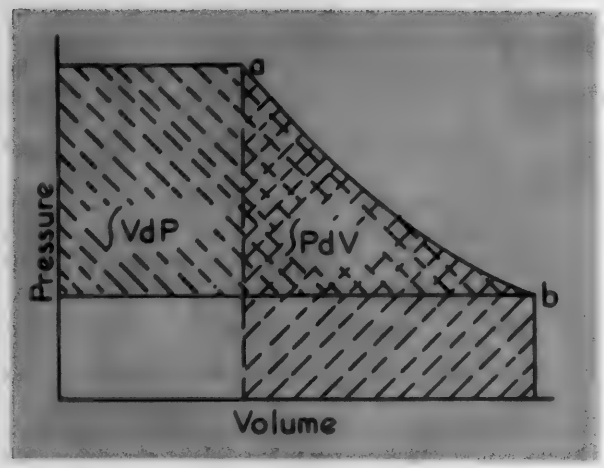



Fig. 6. Comparison of process work with cycle work.

system in contrast with $\int PdV$ which gives the work done on a given quantity of material which is acted on during a single process and remains within the operating equipment.

Application of the above concept to a flow system in which—as in a reciprocating engine—a fluid flows through a cylinder and is polytropically expanded gives the following equation

Work of polytropic expansion cycle
= Work delivered during admission + work delivered during expansion + work received during discharge.

$$= AP_1\nabla_1 + [(AP_1\nabla_1 - AP_2\nabla_2)/(n-1)] - AP_2\nabla_2$$

$$= [n/(n-1)]\,[A(P_1\nabla_1 - P_2\nabla_2)] \qquad (25)$$

which differs from the equation for a nonflow polytropic expansion only in the presence of $n$ as a multiplying factor. But $n$ usually ranges from 1.0 to 1.4, hence it is evident that the polytropic cycle delivers up to 40% more work than does the polytropic process for which the exponent has the same numerical value. Substituting from equation 25 back into 23,

$$w(h_1 - h_2) - q_{out} = [n/(n-1)]\,[A(P_1\nabla_1 - P_2\nabla_2)] \qquad (26)$$

from which it is evident that the change of enthalpy during a polytropic process can be calculated from the initial and final pressures and specific volumes if the rate of heat loss is known and provided the polytropic exponent is likewise known. For an isentropic process the heat loss term drops out of equation 26 and the change of enthalpy can then be evaluated in terms of pressures and volumes provided the exponent for such a process has been previously determined.

### Enthalpy Change

In most cases in practice, however, the use of the energy equation as a means of evaluating enthalpy change is unlikely since, if the initial and final values of pressure and specific volume are known, it will necessarily mean that the initial and final states have been established; knowing the states of the working substance will almost always (for a given fluid) permit direct determination of the enthalpy, as well as all other properties, hence will permit direct and immediate evaluation of the enthalpy difference.

*Example 9*: Determine the shaft work needed to isothermally compress 20 cubic feet per minute of atmospheric air to 3 atmospheres pressure under conditions of steady flow; compare the result with that for the nonflow compression which was discussed in example 5. Determine the required cooling water flow rate if the temperature rise of the cooling water is held to 2 F.

*Solution*: From equation 25 (and noting the sentence below the equation), for any polytropic compression,

$$Wk_{cycle} = (n)\,(Wk_{process})$$

The process work for this case has already been determined (example 5) as 60 Btu, hence—since the value of $n$ for isothermal compression is unity—the work of the isothermal cycle has the same value, 60 Btu.

In order for the above result to be true it is evident from the first form of equation 25 that the work delivered to the piston by the air during the process of constant-pressure admission must be exactly equal to the work done on the air by the piston during the process of constant-pressure discharge; in short, the flow work associated with the leaving air, $AP_2\nabla_2$, must be equal to the flow work associated with the entering air, $AP_1\nabla_1$. That this condition is met is evident from the defining equation for a polytropic (with $n$ equal to unity for an isothermal),

$$P_1V_1 = P_2V_2$$

Then, since neither the flow work nor the internal energy change during an isothermal compression cycle, it folows that the enthalpy remains constant; hence by equation 26,

$$q_{out} = Wk_{in} = 60 \text{ Btu}$$

The required rate of flow of cooling water (for the stated 2F temperature rise) is,

Flow rate = 60/2 = 30 lb per min, or 30/8.345 = 3.6 gallons per minute.

*Example 10*: For the conditions of the preceding example calculate the cycle work for isentropic compression and compare with the process work for isentropic compression.

*Solution*: As discussed in the preceding example the cycle work for any polytropic is $n$ times the process work. Taking the isentropic exponent for air as $c_p/c_v$ or .24/.17 or 1.4 it follows that the cycle work is 40% greater than the process work or (taking the process work as calculated in example 7),

$$Wk_{cycle} = (1.4)\,(50) = 70 \text{ Btu per min}$$

Note, therefore, that the work of the isentropic cycle (70 Btu) exceeds the work of the isothermal cycle (60 Btu), though the process work for isentropic compression (50 Btu) is less than the process work for isothermal compression (60 Btu).

*(2) Pressure-Raising Equipments.* Practically all heat-power equipments which receive shaft work have as their major purpose the raising of the pressure of the working substance which flows through them. The reasons for desiring a higher pressure differ depending on the type of equipment, but invariably the need for shaft work is directly related to the need for increasing the potential which pressure represents. In refrigeration compressors the higher pressure is needed as a means of raising the saturation temperature of the refrigerant, whereas with air compressors the higher pressure often is required in order to permit subsequent work realization from a process (as in an air hammer) of expansion. In pumps and fans the work input is largely utilized in increasing the flow work of the fluid and thereby providing an energy source from which can be made up the losses due to pressure drop resulting from friction in the ducts or piping.

### Fan Performance

The major difference in performance of a fan as compared with an air compressor is that the work input to the fan is used to provide flow work, whereas with an air compressor a substantial fraction of the work added is required to bring about the process of compression. This difference is evidenced in Fig. 7; the *a* part of the figure shows a typical pressure-volume diagram for a fan with relatively negligible work under the process line, whereas the *b* part shows work input to an air compressor with a very large fraction of required energy being represented by the area under the process line.

As applied to pressure increasing equipments the basic energy equation 22 takes the form,

$$AWk'_{in} = w(h_2 - h_1) + q_{out} \qquad (27)$$

The form of the above equation is deceptive since it seems to indicate that the work of compression will be increased as a result of cylinder cooling. Actually work input *decreases* as $q_{out}$ increases, the aparent inconsistency being due to the fact that the term representing enthalpy change is not an independent variable, hence it will be found that any increase in $q_{out}$ always has associated with it an even greater decrease in enthalpy. Application of equation 27 to a few problems will demonstrate the accuracy of the statements concerning the work-heat relationship, but in using the equation care must be exercised as it is not uncommon to fall into error by incorrectly changing the sign of the $q_{out}$ term through belief that its present form is in "obvious" error.

*(3) Pressure-Reducing Equipments.* The reduction of pressure for any reason other than to secure extraction of shaft work or to increase velocity always involves friction, hence is thermodynamically undesirable. In practice, however, many situations arise for which fluid pressure must be lowered and not infrequently the circumstances of the pressure-reduction are such that work extraction is impracticable. In transporting gaseous materials by pipeline, for example, the pressure is first raised to a moderate value in order to decrease the specific volume and thereby reduce the required size of piping. At the point of utilization the gas pressure may have to be reduced (as when natural or producer gas is admitted to the combustion equipment in a residence), but the amount of work that could be made available from the pressure reduction is small and the need for such shaft work at the point where it would be released may be negligible, hence the cost and complexity of equipment for transforming thermal energy to shaft work may not be justified.

### Flow Through Valves

In the great majority of cases economy of design requires selection of the least expensive type of equipment, hence some type of pressure-reducing or "throttling" valve is most commonly used. In cases of this kind the energy equation 22 drops its work term and reduces to the form*,

$$q_{in} = w(h_2 - h_1) \qquad (28)$$

But flow through a valve is likely to occur so rapidly that there will be no appreciable opportunity for transfer of heat between the working fluid and the surroundings; in this case the process is adiabatic and equation 28 sim-

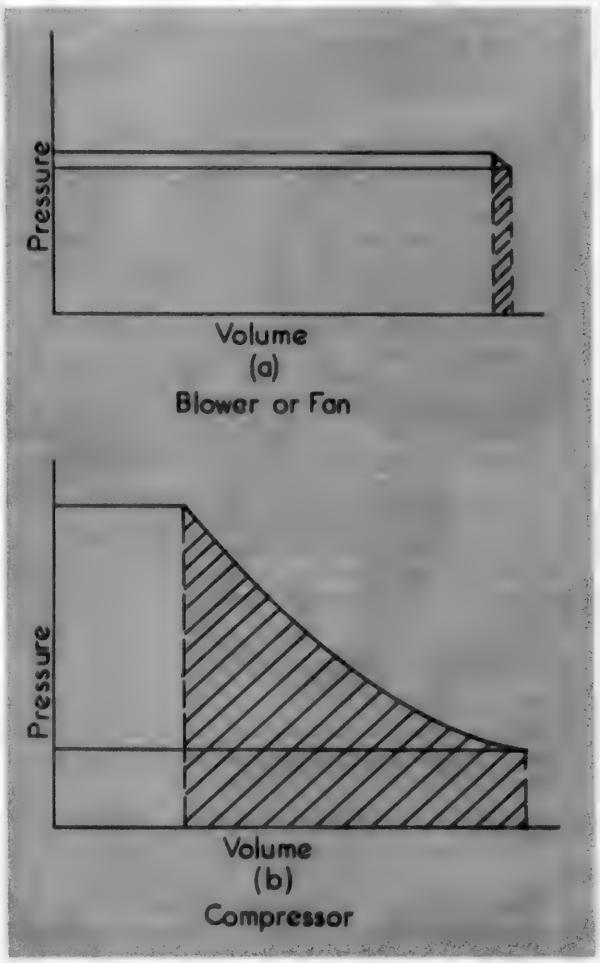



Fig. 7. Process work versus cycle work.

*Assuming that initial and terminal velocities are either negligible or of the same order of magnitude; if throttling develops a discharge velocity much greater than the initial velocity, it would then be necessary to add a kinetic energy term.

plifies to a statement that, for an adiabatic throttling process, there can be no enthalpy change of the fluid,

$$h_1 = h_2 \qquad (29)$$

Equation 29 is applicable to all types of pressure-reducing valves, whether for compressible or for incompressible flow, and serves also to define the required relationships which must exist in refrigeration expansion valves.

It is interesting to note that application of equation 29 to pressure-reduction of such a fluid as water shows that any drop in pressure of the water during passage through a valve must be accompanied by an increase in temperature; in order for the enthalpy to remain constant, the reduction in flow work which accompanies pressure reduction must wholly appear as an increase of internal energy of the downstream fluid. As an example consider water flowing through a pipe at 250 psia and consider that its pressure is to be reduced to 25 psia; by equation 29 (taking the specific volume of the water as approximately constant at 0.016 cu ft per lb),

$$u_1 + 250(144)(0.016)/778 = u_2 + 25(144)(0.016)/778$$

or

$$\triangle u = 0.67 \text{ Btu per lb}$$

The specific heat of water is approximately unity, hence the temperature rise associated with this pressure drop of 225 lb is less than 1F; it is evident, therefore, that throttling of an incompressible fluid is hardly an effective method of heating such a fluid.

*(4) Heat-Exchange Equipments.* A large group of common equipments, including furnaces, boilers, superheaters, subcoolers, condensers, and heat exchangers, have as their primary purpose the transfer of heat to or from the working substance as it passes through the equipment. In all such cases the energy equation reduces to the form,

$$q_{in} = w(h_2 - h_1) \qquad (30)$$

which shows that the energy received by the fluid either goes into storage in internal form or appears as an increase in the associated flow work.

### Non-Thermal Flow Systems

For flow systems in which an incompressible fluid passes through a closed conduit without gaining or losing either heat or shaft work the general energy equation (18) reduces to the form,

$$AP_1\nabla_1 + Az_1 + Av^2_1/2g = AP_2\nabla_2 + Az_2 + Av^2_2/2g \qquad (31)$$

If change in elevation is small the potential energy terms can be dropped and the equation re-written (with substitution of units of ft lbs for Btu),

$$P_1\nabla_1 + v^2_1/2g = P_2\nabla_2 + v^2_2/2g \qquad (32)$$

In order to change equation 32 from a unit weight basis to a unit volume basis, it is necessary to divide by the specific volume, giving,

$$P_1 + v^2_1/2g\nabla_1 = P_2 + v^2_2/2g\nabla_2 \qquad (33)$$

But for incompressible flow $\nabla_1 = \nabla_2$ and $1/g\nabla$ is equal to the mass density, $\rho$, of the fluid; thus,

$$P_1 + (1/2)(\rho v_1^2) = P_2 + (1/2)(\rho v_2^2) \qquad (34)$$

which is the common form of Bernoulli's equation for non-thermal incompressible flow. As used in the Bernoulli equation pressure is an energy term having units of ft lb of flow work *per unit volume* of fluid; the equation states that the sum of flow work and of kinetic energy possessed by a volume of fluid remains unchanged throughout the flow process.

*Example 11*: Air flows through an expanding 200 foot long duct under conditions such that the static pressure remains constant. If the entrance velocity is 3000 feet per minute and if friction losses through the length of duct amount to 0.003 psia, determine the exit velocity.

*Solution*: The energy loss of (0.003)(144) psfa is equal to the quantity of flow work (per unit volume) which is dissipated from the duct either as heat or as an increase in the kinetic energy (hence the temperature) of the air. But the expanding duct makes up for the energy dissipation by converting kinetic energy to flow work at a rate equal to the loss of flow work as friction. Hence the velocity must decrease, through the length of duct, sufficiently to provide a make-up of (0.003)(144) = 0.432 ft lb. Letting $v_2$ equal the final velocity,

$$v_1^2/2g - v_2^2/2g = 0.432$$

or

$$(3000/60)^2/64.4 - v_2^2/64.4 = 0.432$$

giving,

$$v_2 = 49.7 \text{ fps or } 2980 \text{ feet per minute}$$

### Velocity-Raising Flow Systems

In many types of heat-power systems—of which the steam turbine is an example—the partial transformation of thermal energy to shaft work is accomplished in two series-connected steps involving transformation first of thermal energy to mechanical energy (in kinetic storage) with subsequent (or in some cases simultaneous) transformation of the kinetic energy to work. In effect, the velocity of the working fluid is raised at the expense of a loss of internal energy and subsequently the fluid is slowed down under theoretically frictionless conditions which allow transformation of the kinetic energy to shaft work.

When a fluid is allowed to expand under conditions of nonflow as in an engine cylinder—the work of expansion leaves the system directly (neglecting losses) as shaft work. When expansion takes place superimposed on flow, the work of expansion (neglecting friction) is fully used in accelerating the fluid and thereby increasing its stored kinetic energy. In either event, whether flow or nonflow, the work done during the process of expansion is the same in amount and can be evaluated by the same equations.

The most simple type of device for raising fluid-velocity is a nozzle. For such an equipment the energy equation becomes,

$$Av_1^2/2g + h_1 = Av_2^2/2g + h_2$$

or

$$(A/2g)(v_2^2 - v_1^2) = (h_1 - h_2) \qquad (35)$$

### Nozzle Applications

As previously indicated the kinetic energy possessed by the working substance as it flows through connecting piping is almost always negligible, hence in most nozzle applications the admission velocity can be taken as zero. With this simplification the above equation can be placed in more convenient form giving an explicit evaluation of the velocity of fluid as it leaves the nozzle,

$$v_2 = (2g/A)(h_1 - h_2)^{1/2} = 223.7(h_1 - h_2)^{1/2} \text{ ft per sec} \quad (36)$$

*Example 12*: Steam enters a nozzle at negligible velocity and leaves at 1700 feet per second. Assuming subsequent 100% conversion of kinetic energy to shaft work determine the power delivered per lb per min of steam and determine the enthalpy drop of each pound of steam as it passes through the nozzle.

*Solution*: By equation 36 the enthalpy drop is evaluable as

$$\triangle h = v_2^2/223.7^2 = (1700/223.7)^2 = 57.8 \text{ Btu/lb}$$

For 100% conversion, the horsepower delivered by each lb per min of steam is,

$$hp = \triangle h/42.42 = 57.8/42.42 = 1.36$$

### Flow With Energy Storage

In the systems which have been considered under preceding steady-flow sections the inflow of mass and of energy was assumed equal to the outflow of mass and of energy; although these two assumptions are applicable to most systems, there are exceptions where either or both require re-examination. In a simple steam radiator, for example, conditions during the warm-up period will be such that both mass and energy will be accumulating in the radiator, whereas for a steam engine or an internal combustion engine conditions during the warm-up period will be responsible for accumulation of energy (due to increase in the mean temperature of the structural parts of the equipment), but without accumulation of mass.

In general, there are so few flow systems involving mass storage, and those few so relatively unimportant, that special forms of the energy equation need not be developed for this case; it is, however, necessary to write the energy equation for systems to which the continuity equation applies (mass entering is equal to mass leaving), but for which an accumulation or diminution of energy within the system does take place. Thus, referring to equation 19, the second storage term can be dropped out and for a single flow rate $w$ and a single weight of stored material, $w_s$, the quation simplifies to the form,

$$(q + AWk')_{in} + w(Az_1 + [Av_1^2/2g] + h_1) = (q + AWk')_{out} + (Az_2 + [Av_1^2/2g] + h_2) + w_s\triangle(Az_s + [Av_1^3/2g] + u_s) \quad (37)$$

If external kinetic and potential changes are slight and if heat and work are shown as a net transfer into the system, the equation simplifies to,

$$(g + AWk')_{in} = w(h_2 - h_1) + w_s\triangle u_s \quad (38)$$

which shows that all energy transferred to this flow system as heat or work must appear as an enthalpy increase of the working substance flowing through the system or as an internal energy gain of the material which is contained within the system.

*Example 13*: A turbine receives steam at a rate of 290,000 lb per hr. The enthalpy of the steam at entrance is 1284 Btu per lb, whereas its exit enthalpy is 950 Btu per lb. At the entrance to the turbine the steam line is 20 ft above the floor and at exit it is 10 ft above the floor. Entering velocity is 4000 fpm and leaving velocity is 9000 fpm.

At a given instant during the warm-up period the turbine is delivering 36,000 horsepower and the calculated rate of heat loss from the casing to the surroundings is 2,400,000 Btu per hr. Determine, for this instant, the rate at which energy is going into storage in the turbine.

*Solution*: Applying equation 37 to this system and noting that the storage term reduces to $w_s\triangle u_s$,

$$w(Az_1 + Av_1^2/2g + h_1) = (q + AWk') + w(Az_2 + Av_2^2/2g + h_2 + w_s\triangle u_s$$

290,000 [20/778 + (4000/60)²/(2) (32.2) (778) + 1284]

= [2,400,000 + (36,000) (2545)] + 290,000 [10/778 + (9000/60)²/(2) (32.2) (778) + 950] + $w_s\triangle u_s$

$w_s\triangle u_s = q_s = 290{,}000$ (0.0128 − 0.363 + 334) − 94,000,000

= 96,800,000 − 94,000,000 = 2,800,000 Btu/hr

*Example 14*: Determine the percent error that would have been introduced in the above example if the changes in potential and kinetic energy had been neglected.

*Solution*: Equation 38 now simplifies to the form,

$$q_s + 290{,}000\ (1284 - 950) - 2{,}400{,}000 - (36{,}000)\ (2545) = 2{,}400{,}000 \text{ Btu per hr}$$

The error is then,

$$[(28 - 24)/28]\ 100 = 14.3\%$$

In this case it is evident that neglect of the mechanical energy would have led to serious error. Note, however, that the energy to storage is of the order of only 2% of that suplied to the turbine, hence the error—based on total energy involved—is really less than 1%. This example shows that for transient conditions — as starting, changing load, or stopping—mechanical energy should be considered.

### Flow to Nonflow Systems

When flow occurs from a pipeline to a compressor, or engine cylinder, or receiver of any kind, the entire quantity of energy possessed by, or associated with, the fluid in the line must enter storage in internal form in the fluid within the receiver. It is true that immediately after admission to the receiver the fluid may retain some motion, hence contain some stored kinetic energy, but fluid friction will eventually lead to dissipation of this kinetic energy with transfer to internal energy, hence from the overall standpoint (provided there is no loss of energy from the receiver as either work or heat) all entering

energy can be considered to go to internal storage. The energy equation for this case can then be written from equation 38 by dropping the term which gives energy associated with the leaving fluid; thus,

$$(q + AWk')_{in} + wh_{in} = w_s\Delta u_s + wu_s = [(w + w_s)u_{s2} - w_s u_{s1}] \quad (39)$$

where $u_{s1}$ and $u_{s2}$ are the respective internal energies of the material in the receiver before and after the admission of fluid. In the greater number of flow-to-nonflow systems there is neither heat nor work addition, in which case the equation simplifies to,

$$wh_{in} = (w + w_s)u_{s2} - w_s u_{s1} \quad (40)$$

and for the even simpler case in which flow occurs to an initially empty receiver the equation becomes,

$$wh_1 = wu_s$$

or

$$h_{line} = u_{receiver} \quad (41)$$

### Internal Energy

Equation 41 shows that cessation of flow is always accompanied by an increase of internal energy in the flowing material, the magnitude of the increase being equal to the associated flow work. If the material in the pipeline is a liquid, vapor, or gas, the increased internal energy will necessarily result in a temperature rise, whereas if an equilibrium mixture of liquid and vapor is flowing in the line, the result of flow stoppage will be an increase in the internal potential energy of the mixture with consequent flashing of some of the liquid to vapor. Under certain circumstances the temperature rise associated with a flow to nonflow process can lead to results which may be confusing to an observer who is unfamiliar with the thermodynamics of such systems. Thus if a boiler produces superheated steam at a temperature of 300F and if this steam flows through a perfectly insulated pipeline to a distant receiver, the temperature of steam within the receiver would necessarily exceed that of the steam leaving the boiler.

For the general case of flow to a partially full receiver from a line higher than the receiver and from a line in which the fluid velocity is $v_1$, equation 39 becomes,

$$(q + AWk')_{in} + w(Az_1 + Av_1^2/2g + h_1) = (w + w_s)u_{s2} - w_s u_{s1} \quad (42)$$

which assumes selection of the datum for measurement of potential energy as the elevation corresponding to the center of gravity of the receiver (thus $z$ for the receiver is zero). For flow to a receiver that is initially empty equation 42 simplifies to,

$$(q + AWk')_{in} + w(Az_1 + Av_1^2/2g + h_1) = wu_s \quad (43)$$

and for the special but common case of flow without significant energy transfer as heat or work this equation further simplifies to a form analogous to equation 41,

$$Az_1 + Av_1^2/2g + h_1 = u_s \quad (44)$$

*Example 15*: A gas flows under steady and continuous conditions from a pipe line to a tank which is 100 ft lower than the pipe line. Velocity in the connecting line, ahead of the pressure reducing valve, is 50 fps and the enthalpy at the same point is 80 Btu per lb. The tank initially contains 10 lb of gas having an enthalpy of 30 Btu per lb; twenty additional pounds of gas flow into the tank from the line. Determine the internal energy of the resultant mixture of gas after the system reaches equilibrium (consider the tank as perfectly insulated, but consider equilibrium as depending on the mixture of gases having come to rest).

*Solution*: For this case equation 42 simplifies to the form,

$$w(Az_1 + Av_1^2/2g + h_1) = (w + w_s)u_{s2} - w_s u_{s1}$$

and by substitution,

$$20[(100/778) + 50^2/(778)(64.4) + 80] = (20 + 10)u_{s2} - (10)(30)u_{s2} = 63.4 \text{ Btu per lb}$$

*Example 16*: A perfect gas at 50 psia, with specific volume of 5 cu ft per lb, has an internal energy at 60F which is greater by 10 Btu per lb than its internal energy at 0 F. One pound of this gas flows from a pipeline to an evacuated receiver. Neglecting heat transfer, determine the temperature of the gas after it has come to rest in the receiver.

*Solution:* By equation 41,

$$h_{line} = u_{line} + (AP_{line} = \overline{V}_{line}) = u_{receiver}$$

$$u_{receiver} = 10 + [(50)(144)(5)]/778 = 56.3 \text{ Btu per lb}$$

But for a perfect gas the ratio of internal energy difference is as the ratio of temperature difference; therefore

$$(t_r - 0)/(60 - 0) = t_r/60 = u_r/u_1 = 56.3/10.0$$

giving

$$t_{receiver} = 337.8\text{F}$$

### Kinetic and Potential Energy

For most heat-power applications the kinetic and potential energy of the entering fluid is negligible in comparison with its flow work, hence equations 40 and 41 are the energy equation forms which find widest use in practice. In looking at the equations for flow to nonflow it is particularly interesting to note that the internal energy in the receiver is fixed independently of the final receiver pressure; whether receiver pressure is brought up to the line value or reaches a final value far below the line pressure the resultant internal energy — for a given weight of admitted fluid — is fixed in terms of the initial value of the internal energy of fluid originally contained within the receiver and of the energy possessed by or associated with, the entering fluid.

Two of the more important applications of the flow to nonflow relationships are in Hirn's analysis of steam engines and the analysis of dual-effect refrigerant compressors. With the exception of these two applications the flow to nonflow condition rarely applies, as interest in actual equipments almost always centers on evaluation of performance under steady flow and steady load conditions; the nonflow relationships are important, however, in evaluating transient conditions during change of load, sudden cessation of flow, or emergency shutdown.

LOUIS BLENDERMANN ON

# PIPING AND PLUMBING

## Protection of Site Utility Lines

NEW buildings that are now being erected, are completed in relatively short periods of time. Careful planning, improved methods of construction and modern equipment have made this possible.

In fact, the construction work on a project generally

### Long Life Necessary

proceeds at such a rapid pace that it is not unusual to see many of the component parts of a building progressing at the same time. Even though the work proceeds at this rate, one must remember that the project is intended to endure for a good number of years.

Therefore, the engineer designing the plumbing systems must take every precaution to ensure that his services and equipment are properly installed. This means, that not only should his work be adequately designed and specified, but in addition the components should be carefully protected during the installation.

### Utilities for the Project

Figure 1 illustrates a typical arrangement of utilities for a project containing a group of six apartment house buildings. The utilities, consisting of sanitary, storm and water lines were installed between the buildings and they connect with existing street utilities. Only these particular three lines have been shown in order to simplify the discussion.

The proper protection of the site or project utilities is a serious problem, since often the utilities are installed in the early stages of construction in order to provide water and drainage facilities required by the construction work. Although the piping is tested and inspected after it is installed, and despite the fact that the contractor provides a workmanship guarantee for a period of a year or more after installation, leaks can still develop. After the backfill has been applied to the pipe trench, it is often impossible to detect leakage caused by pipe settlement, due to heavy loads passing over the trench.

It may take several years to discover that a serious leak is existing, but such a leak can cause buildings to settle and crack and finished grade to sag or wash away. In addition, the discharge of raw sewage into the ground can create a menace to public health. While good design and the proper selection of materials will assure a sound system, however, unless the piping is protected after installation, the careful consideration given, will have been wasted.

### Measure of Protection

Assuming that fill is not encountered at the site and that the piping is installed in trenches which have been excavated in natural earth. If the trench bottom is accurately graded for the slope of the piping, the utilities will function properly. Furthermore, if bell holes are cut in the trench bottom for the hubs of the piping and if the backfill is carefully handled, the utilities may be considered properly supported and well installed.

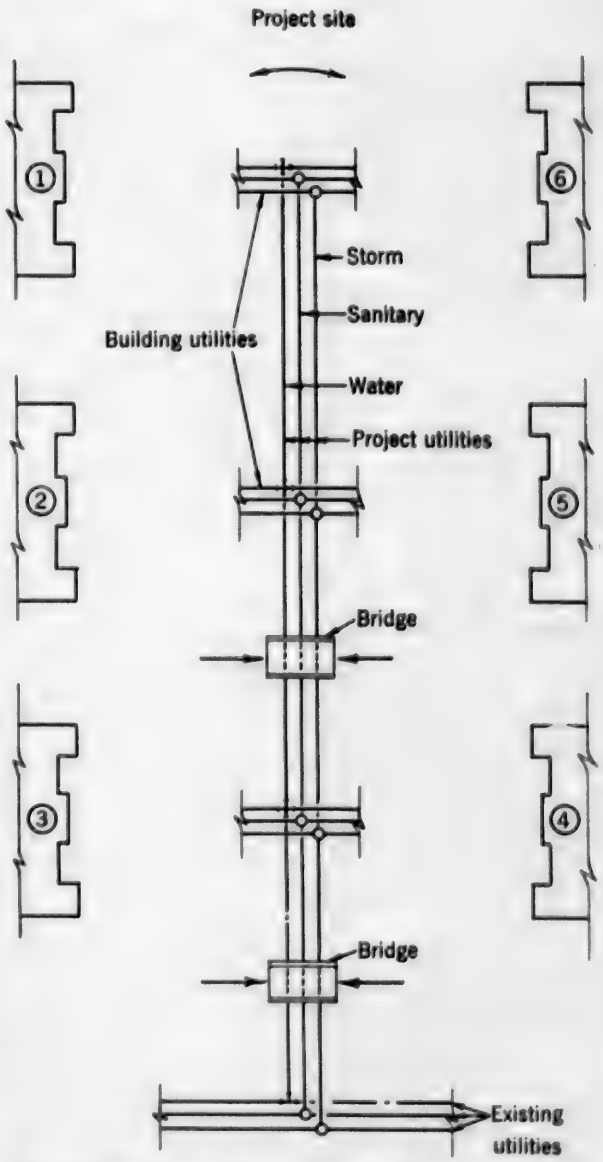



Fig. 1. Typical layout of site utilities and location of bridges. Valves and other equipment are not shown.

Figure 2, indicates a typical arrangement of the underground utilities and the manner in which they are supported. As shown in this illustration, the utilities are installed on the bottom of a trench which has been carefully excavated with a minimum of disturbance to the natural earth, thereby assuring a good firm support for the piping. The storm and sanitary lines were installed with the proper slope to satisfy the elevations of the buildings and the finished grading. Care has been exercised in excavating the trench to provide a shelf or ledge

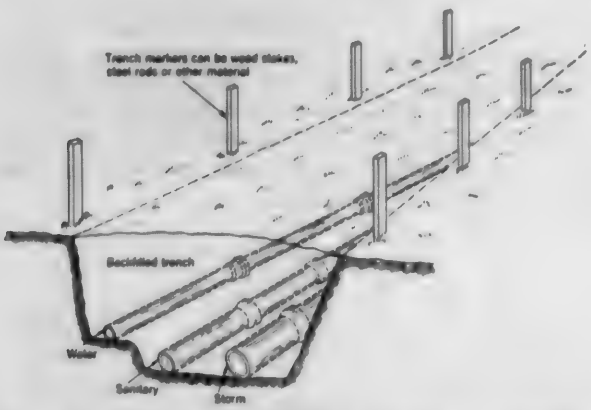



Fig. 2. Installation of utility lines in a trench. As a protective measure, trench markers are used to show trench limits.

of natural earth for the support of the water line. This procedure lessens the possibility of pipe settlement with its resulting damage.

### Dangers to Underground Utilities

If the wall thickness of the piping shown in Fig. 2 has been adaquately specified for the working pressure, size and function of the lines, and if the backfill has been carefully handled, the lines should withstand reasonable amounts of weight or pressure exerted on the grade, directly over the piping.

However, at a site similar to the one shown in Fig. 1, there is a continual movement of heavy trucks, delivering the necessary construction material for the buildings. In addition, cranes, bulldozers and other types of heavy equipment are also being moved over the trenches and present a serious danger to the utilities. The result is that the piping will be subjected to unusual loads and strains for which it has not been designed. This can crush the pipe or cause the lines to settle to the extent that leaks will develop.

### Bridges to Span Trenches

To avoid this, it is necessary to take certain steps to protect the utilities. One such precaution is to provide bridges that span the width of the trenches. The bridges are located at points over the trench, best suited for movement of heavy equipment as determined by the needs of the various contractors. The bridges are generally built and maintained by the general contractor. A typical location of bridges is shown in Fig. 1. Two bridges are required and have been so located to provide the best access to either side of the trench. A third bridge was not considered since access to either side of the trench is available in the area of the curved arrow. However, Fig. 1 is only an example, for other projects may require different and more numerous locations. The required width of the bridge is dependent upon the size of the largest piece of equipment to be moved. This is usually determined by the general contractor.

The bridge itself may consist of timber planks or steel plates, supported on a framework of heavy timber and piling at either side of the trench. In addition, underground supports are usually extended from the piles to the center of the span.

The building utilities should be provided with similar bridging protection if the utilities are installed early during the construction stages. Often these building utilities are not installed until the construction is well advanced.

The purpose of the bridge is to distribute a heavy load passing over the trench away to the framework rather than directly over the piping. The material used for the bridge and the method of construction is the responsibility of the general contractor.

It is the responsibility of the engineer to make certain by provisions on drawings or in the specifications, that the plumbing contractor will know this protection is called for so that he can bring it to the attention of the general contractor.

### Trench Markers

In addition to providing bridges over the pipe trenches at specific locations, it is also necessary to make certain that the bridges will be used and that equipment will not be moved over other portions of the trench.

This can be accomplished by setting stakes or markers along the sides of the trench, denoting the location of the backfilled trench. The stakes will allow workmen to cross the trench, but will indicate the location of the trench which trucks and other necessary heavy equipment are to avoid.

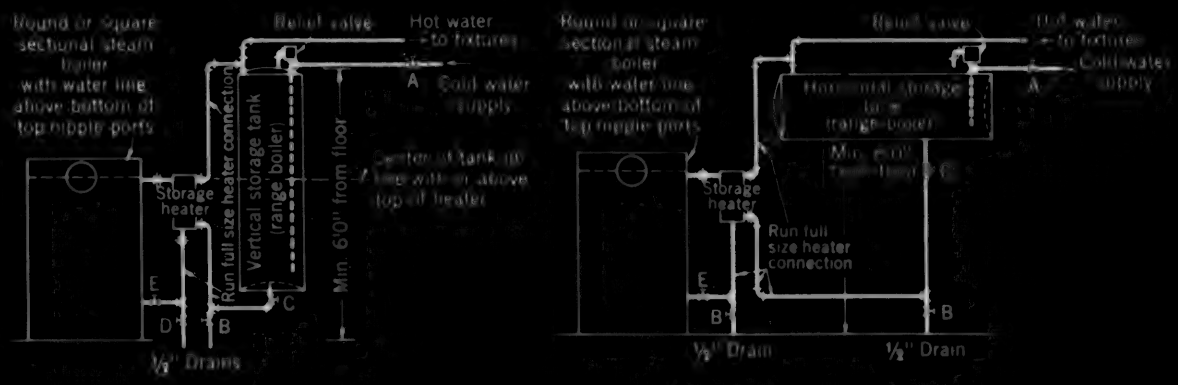
Figure 2 illustrates such a system of trench markers. The stakes are easily set and can be removed when it is certain that the heavy equipment will no longer be moved over the trench. The trench markers will also discourage the stockpiling of heavy construction materials over the pipe trench.

These precautions are just a few of the necessary steps to be taken for the protection of the site utilities. If the piping systems are expected to last for a good number of years, then they should at least be installed with care at the start.

It is fortunate on most projects that both the plumbing contractor and the general contractor give this problem adequate consideration, and take the necessary precaution to protect the piping. However, this is not always the case. Therefore, any consideration the engineer can give this matter, either by instructions on the drawings or in the specifications, will assure the necessary protection of the installed piping.

*The next article for this department will consider the problem of fixture roughing for low rent housing projects. It will present a typical layout of kitchen and toilet fixtures for an apartment with the minimum of space between fixtures.*

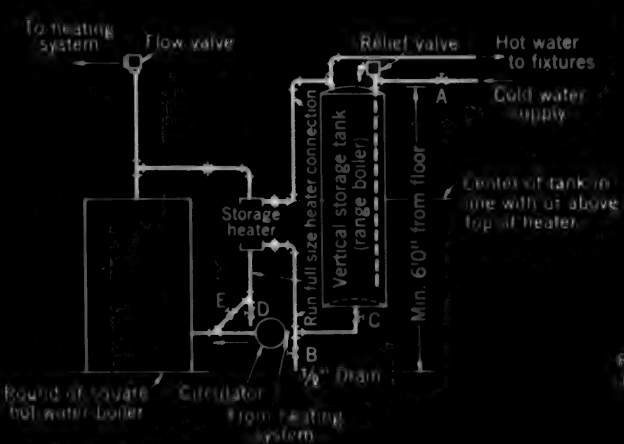
# INDIRECT WATER HEATERS




EXTERNAL STORAGE HEATER WITH ROUND OR SQUARE SECTIONAL STEAM BOILER WATER LINE ABOVE BOTTOM OF TOP NIPPLE PORTS

Detail of tank connection

Detail of tank connection



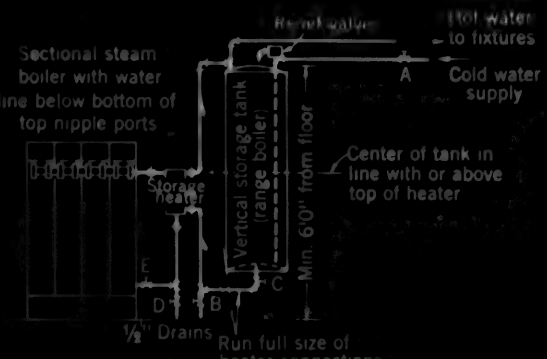

EXTERNAL STORAGE HEATER WITH ROUND OR SQUARE SECTIONAL HOT WATER BOILER SYSTEM FOR SUMMER WINTER OPERATION

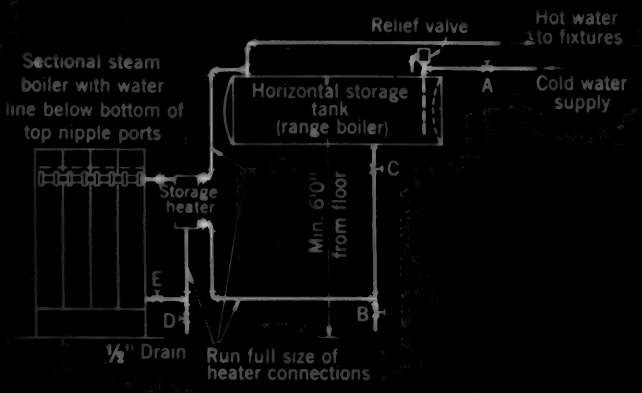
Detail of tank connection

Detail of tank connection

CUT ALONG THIS LINE

# INDIRECT WATER HEATERS




Detail of tank connection

Detail of tank connection

Alternate header details

| Size of tapping in each section | | | |
|---|---|---|---|
| Header size, inches | Sections in boiler | | |
| | 3 | 4 | 5 |
| | Tapping size, inches | | |
| 1 | ¾ | 1½ | 1½ |
| 1¼ | ¾ | ¾ | ¾ |
| 1½ | 1 | 1 | ¾ |

Keep top of header below water line
Lower header must be vented by ½" line
to any opening in boiler above header

EXTERNAL STORAGE HEATER FOR SUMMER WINTER OPERATION WITH SQUARE SECTIONAL STEAM BOILER

TO FLUSH TANK AND HEATER

To flush out tanks, open valves A, B, and C.
To flush out coil of heater, close valve C, open valves A and B.
To flush out shell of external heater, close valve B, open valve D.

DRAWING THROUGH THE COURTESY OF THE INSTITUTE OF BOILER AND RADIATOR MANUFACTURERS.

## Installation and Operating

# Costs Cut by Mechanical Draft

W. J. MATIEZ

L. J. Wing Mfg. Co., Linden, N. J.

**Tall stacks to provide natural draft for boilers are costly to install and maintain. A discussion of mechanical vs. natural induced draft, plus case histories of plants that replaced natural draft with mechanical draft inducers, show that it is possible to obtain considerable savings in both installation and boiler plant operating costs.**

DURING the past decade, the mechanical draft inducer has been rapidly supplanting tall stacks in providing draft for boilers. This transition is the direct result of efforts by architects and engineers to keep down capital and fuel costs, and also to improve architectural appearance.

Advantages derived from mechanical induced draft

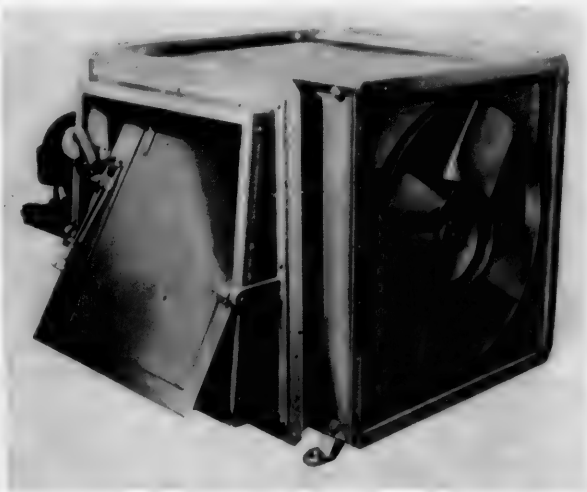


Fig. 1. Mechanical draft inducer which replaces an elbow in the breeching.

have been well demonstrated over the years. There are numerous case histories which indicate that such equipment, complete with controls, may be purchased and installed at approximately 40 to 60% of the cost of a high stack. Furthermore, attractive fuel savings result from having the exact draft always available to satisfy varying load and weather conditions. Natural draft is most undependable and subject to the vagaries of wind and weather.

### Natural Draft Is Not Dependable

The foremost disadvantage of natural draft, provided by a chimney, is undependability. When a service man, for example, adjusts a burner, he obtains the maximum $CO_2$ commensurate with the draft available at that time. Later as this draft varies, so does the burner efficiency and the $CO_2$.

Chimney draft is poor when the stack is cool and good when it is hot. To allow for this variation, the burner is usually adjusted for average to poor draft conditions. This assures adequate air to prevent smoking on cold starts but results in considerable excess air when the stack is heated. The average $CO_2$ rating and over-all combustion efficiency is consequently very poor. The draft at any time is subject to wide variation from changing weather conditions and/or down-drafts caused by nearby hills or tall buildings. Thus, the serviceman must take these variables into account in making burner adjustments.

In contrast with the uncertainties of natural draft, a mechanical draft inducer provides positive and adequate draft on all occasions, and it eliminates or reduces the smoke resulting from insufficient draft. Thus, burners may be adjusted to operate with high $CO_2$'s where induced draft is employed, resulting in reduced fuel consumption.

### High Operating Efficiency

Indicative of the high operating efficiency made possible by mechanical draft, the following was reported after a recent boiler installation was completed for an oil company.

The original heating plant was equipped with one boiler handling the entire load with draft provided by a stack approximately 50 ft high. A test showed the best operating efficiency of this boiler to be 75%. This occurred on high fire. On low fire the efficiency reduced to a nominal percentage. Plant facilities were expanded and new specifications called for a second boiler identical to

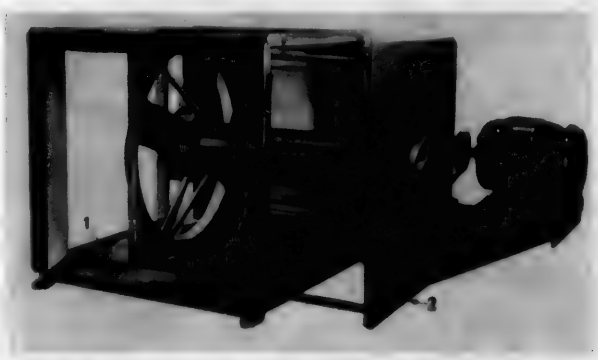



Fig. 2. Another view of unit shown in Fig. 1. For servicing, 1 remains intact. Entire rotating assembly, 2, can be withdrawn from casing.

the first, with additional draft to be furnished by an inducer serving both boilers. Gases from the inducer were to be discharged into the 50 ft stack. When the draft inducer was placed in operation, it was found both burners could be operated at full rating and at 85% efficiency on low fire and 375 deg F stack temperature, and at 83% efficiency on high fire with stack temperature of 425 deg. Thus, in addition to saving the cost of an extra stack, the inducer produced very attractive fuel economies from higher operating efficiencies.

### Draft Inducer Described

There are various types of draft inducers available; Fig. 1 illustrates a popular design which replaces an elbow in the breeching. This breeching need never be disturbed for inspection or servicing.

How this is accomplished is illustrated in Fig. 2. The inducer casing, Item 1, remains intact as connected to the breeching. The entire rotating assembly, however, Item 2, complete with motor, drive, bearing assembly, fan impeller, and supports can be withdrawn from the casing on inner slide rails and worked on at the mechanic's convenience. After servicing, the unit is then replaced in the casing and secured by merely fastening eight bolts.

Fan shaft bearings are protectively concealed within an insulated housing through which cooling air flows continuously. These bearings are prelubricated and sealed, so no additional lubrication is required for their normal life.

The use of a V-belt drive eliminates the need for field alignment before start-up. The shaft and bearings are rigidly mounted at the factory and require no attention. The motor is mounted on a spring base, preset at the factory, which automatically maintains correct belt tension.

This inducer comes complete with two inlet openings. A barometric damper, if specified, may be mounted on one opening, otherwise a cover plate is supplied. The side panels of the casing, which are interchangeable, may easily be changed in the field to locate the gas inlet on either side, top or bottom. The discharge can be horizontal or vertical.

Fig. 3. Installation at the Pepsi-Cola Bottling Co., Cleveland, Ohio.

Fig. 4. Mechanical draft serves two oil-fired boilers in a dairy.

### Capacity May Be Varied

The capacity of the unit may be varied in accordance with the load requirements. This is accomplished with a variable speed motor and a manual speed controller. Thus, to either increase or decrease the capacity, the speed is adjusted by merely turning the handle on the speed controller. Operating at the lowest speed consistent with adequate gas removal results in lower power consumption and reduced wear.

Inducers of the axial flow type are available in several sizes from units serving domestic boilers to steam generators producing up to 100,000 pounds of steam per hour.

Architectural trends toward one-story structures are rapidly spelling the end of tall stacks for boiler draft. Aside from the aesthetic benefits of a short stack, there is a considerable saving in eliminating the maintenance of tall stacks. Both brick and steel types have to be regularly checked for cracks or excess rusting, and pointed up or painted.

### Bottling Plant Shows Savings

Recently, a prominent bottling firm found its steel stack so badly corroded due to rust that repairs were virtually impossible. This company took estimates on an identical replacement, including removal of the original.

The plant consisted of three gas-fired boilers, all discharging into a common breeching leading to the stack, which measured 48 inches in diameter by 60 ft high.

Alternate estimates were also taken for installing three draft inducers, including three short stub stacks. Management was surprised and pleased to learn that an overall saving of 48% could be effected by installing mechanical draft. The estimate included the removal of the existing stack and breeching; installation of new uptakes, and short stub stacks each passing through holes cut in the roof of pre-cast concrete; the purchase of three draft inducers and work incidental to their operation and instal-

lation together with draft gages, panel board fabricated and wired; the purchase and installation of a gravity roof ventilator over the old stack opening; and complete service of all three burners.

Figure 3 shows the work completed and the old tall stack removed. The three inducers with barometrics sufficiently increased the draft to permit the gas flow to be stepped up through the burners by 600 cu ft per hour. Tests showed 10% $CO_2$ with 410 deg flue gas temperature. Since the local ordinances permitted a maximum of 9% $CO_2$, the $CO_2$ level was reduced accordingly.

The bottling company has since reported that the variable speed feature of the draft inducer has enabled greater flexibility in steam production with further economy resulting from reduced power consumption during periods of low load operation.

### Dairy Cuts Operating Costs

Another example indicative of the relative cost between mechanical and natural draft is that of a midwestern dairy installation. Formerly the dairy had two oil-fired Scotch marine boilers discharging through individual steel stacks both 40 in. diameter—one 45 ft high and the other 55 ft high. The taller stack was blown down during a high wind and this damaged the second stack so that both required replacement. The portion of the stack that remained provided enough draft for operation at part load only.

Investigation of the respective costs of rebuilding the original stacks or installing mechanical draft revealed that the cost of stacks exceeded that of mechanical draft by 50%. Five per cent of the cost for mechanical draft covered the removal of the damaged stacks.

The completed installation, Fig. 4, uses one inducer for two boilers. Each of the breechings is tied into opposite inlets on the draft inducer with the inducer discharging vertically through a short stub stack.

The uniform draft provided by the inducer has permitted higher operating efficiencies with a reported 15% savings daily in fuel consumption. Expressed another way, it saved 20 gallons of oil per day at 10 cents per gallon; greater savings were effected during the winter. After the first year of operation, the total fuel cost was reduced approximately $1,000.

The case histories show that considerable savings can be effected through the use of a mechanical draft inducer both in installation and operating costs, in addition to having adequate and dependable draft always available. The development and perfection of mechanical draft has been considered one of the outstanding features in boiler plant design and will continue to supplant tall and unsightly stacks at a rapid pace.

---

## Electronic Brain Speeds Building Studies

A man-sized electronic "brain" that can simulate a house anywhere in the world and analyze its reactions to any kind of weather, from Arctic cold to tropical heat, was unveiled in Minneapolis recently. Developed by research scientists of Minneapolis-Honeywell Regulator Company, the highly-complex "brain" is expected to shorten by as much as five years the time now required for testing home heating and air conditioning equipment and home building materials.

The unit not only can duplicate the thermal characteristics of a house—complete to the effects of such factors as storm windows and insulation, but it can surround the house with any type of weather conditions desired. Even more phenomenally, it can simulate the complete life span of a house in a matter of minutes.

"This house analog, as we call it, should provide us in a relatively short time with knowledge in the air conditioning field comparable to what has been gained in home heating through 70 years of experience," explained Dr. Finn Larsen, Honeywell research director.

In operation, the computer is fed such information about a house as areas involved, construction details such as size and type of doors and windows, type of outside material, insulation and so on. From all of this information it can duplicate the building's thermal characteristics, and determine what happens under varying conditions.

The device is primarily concerned with measuring heat losses and gains as they vary with time.

One second of the "brain's" time is equivalent to 60 days of actual time, which means it has a time factor of approximately 5,000,000 to 1. Entirely new electronic developments incorporated in the device enable it, in testing a house, for example, to repeat the same weather conditions each day of the simulated period. With a simulated 60-day period, this would mean repeating the same daily weather cycle every 1/60th of a second calculated in the "brain's" own time.

"In other words," Dr. Larsen explained, "the analog can, in effect, make weather stand still. Previously, we've had to wait for the right weather conditions to come along —perhaps months or even years—and even then the desired conditions might prevail only briefly. Thus, the opportunity for testing equipment and houses under all weather conditions has been limited."

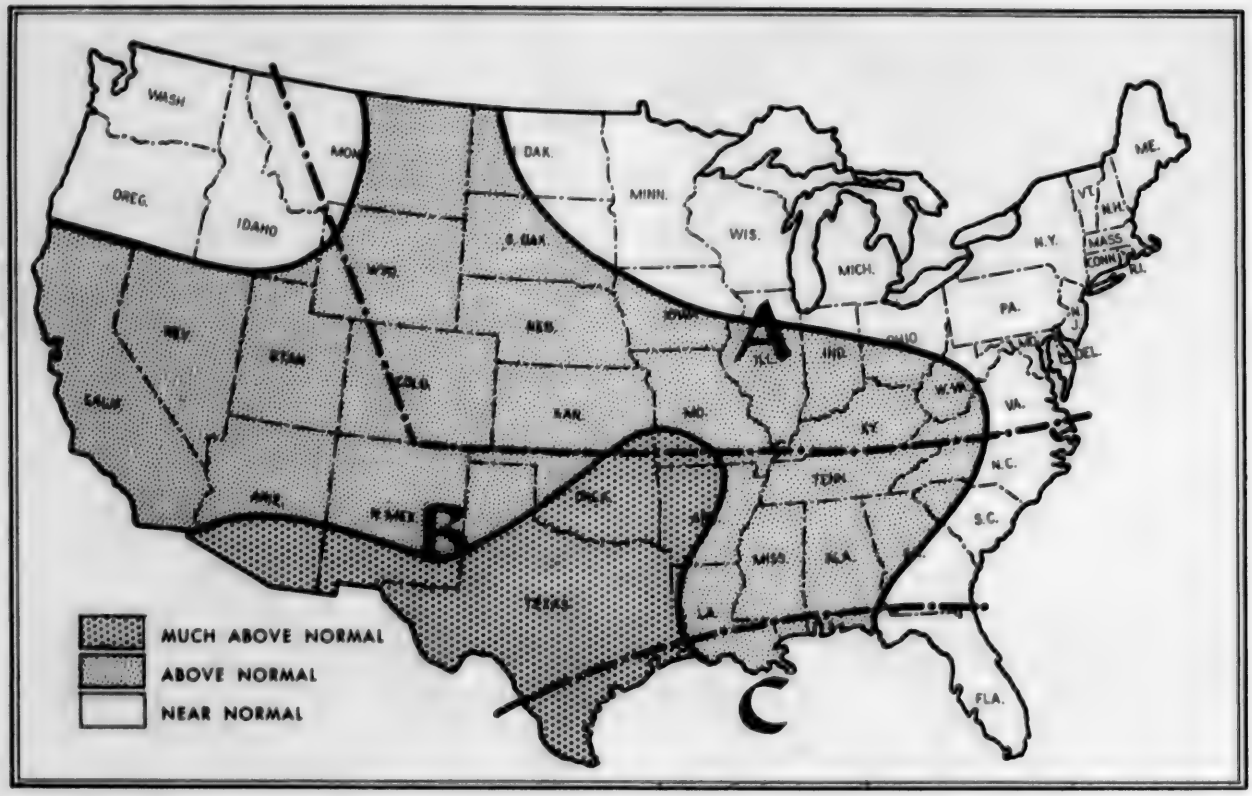
Dr. Larsen said that while the "brain" could be tailored to analyze such unusual structures as igloos and mud huts, it would be put to less spectacular but important use in developing improved heating and air conditioning controls. It will also be utilized to learn new things about home construction and in studying the effects of various climatic factors involved in human comfort as well as other research work.

The unit which stands five feet high, and is two feet by one and one-half feet wide, is known as the component type of analog. Although extremely complex, the device is very flexible. During a house test, storm windows can be quickly taken off or put back on, the type of insulation or other building material can be changed, a switch can be made from one kind of heating or air coditioning system to another, and so on. Existing or new types of control systems can also be simulated and changed simply by turning knobs.

# Temperature Forecast for June

**Prepared for Air Conditioning, Heating and Ventilating**

**by Long Range Weather Consultants**




**KEY BY REGIONS**

| | A | B | C |
|---|---|---|---|
| MUCH ABOVE NORMAL | +4° or more | +4° or more | +3° or more |
| ABOVE NORMAL | +2° to 3° | +2° to +3° | +1° to +2° |
| NEAR NORMAL | +1° to −1° | +1° to −1° | 0° |

THE distribution of temperature departures from normal for June across most of the country is not expected to depart radically from that of May, except for a moderate warming trend in the far west. Temperatures rather close to normal, as an average, will prevail in the far northwest, from coastal Washington and Oregon eastward to the Divide, and generally along the Atlantic Seaboard from Florida to Maine and from the north Atlantic states westward across the Great Lakes to Minnesota and the Dakotas.

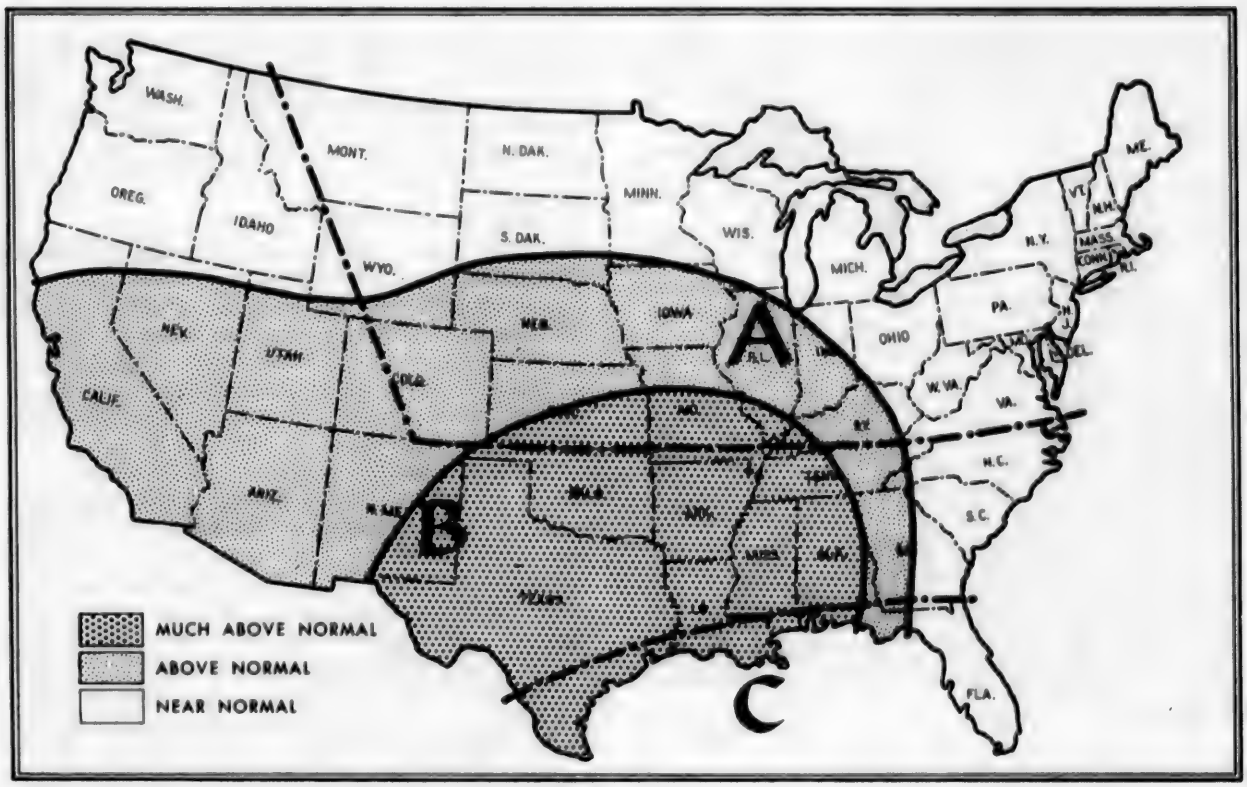
The week to week fluctuations of temperature, however, are expected to continue rather large in both the northeast and in the north central sections of the country.

Largest departures from normal, as much as +4°, probably will occur in southern sections west of the Mississippi particularly in an area extending from Texas northeastward into Oklahoma and Arkansas. Southern sections in general from the Appalachians westward are expected to be rather steadily warm, without the markedly cool intervals indicated for northeastern and north central sections. Temperatures will average moderately above normal (+2° to +3°) in a broad belt extending from California eastward to the Ohio Valley, from Tennessee southward to the Gulf coast, and in the section of the northern Plains extending from the Continental Divide to the central Dakotas.

# Temperature Forecast for Summer

## A forecast for the June, July, August quarter, 1955

**Prepared by Long Range Weather Consultants**




**KEY BY REGIONS**

| | A | B | C |
|---|---|---|---|
| MUCH ABOVE NORMAL | +3° or more | +3° or more | +2° or more |
| ABOVE NORMAL | +2° | +2° | +1° |
| NEAR NORMAL | +1° to −1° | +1° to −1° | 0° |

TO a considerable extent the month of June will set the temperature pattern for the average of the summer season. Generally speaking summer temperatures are forecast to average quite close to the normal across the northern third of the nation, and southward along the Atlantic Seaboard to the Florida peninsula. However, in north central and northeastern sections summer temperatures are expected to be quite variable, with quite cool conditions alternating irregularly with rather warm conditions. Along most of the northern border of the country the temperature probably will tend to average slightly below normal.

Largest temperature departures, persistently rather warm conditions averaging from 3° to 5° above normal for the summer season, are expected to prevail from the central Mississippi Valley and southern Plains southward to the Gulf Coast, and the Rio Grande, with above normal temperatures extending westward from this area to the California Coast, northward through Nebraska, Iowa and Illinois, and eastward to the southern Appalachians. In most of this warm area July is expected to be as much or somewhat more above normal than June, with a return to more nearly normal conditions during the month of August.

# Centrifugal Pump Materials

IGOR J. KARASSIK and ROY CARTER

Centrifugal Pump Division, Worthington Corp., Harrison, N. J.

**This is the final article in a series of thirteen which have presented the physical features and selection criteria for various forms of centrifugal pumps.**

CENTRIFUGAL pumps can be manufactured of almost all the known common metals or metal alloys as well as of porcelain, glass and even some synthetics. It is impossible to present here a listing of all the liquids which may be encountered in centrifugal pump applications and a corresponding tabulation of the materials commonly recommended for each of these liquids. Such a listing can be found in the Standards published by the Hydraulic Institute, as well as in the catalogs and bulletins of pump manufacturers. We shall limit ourselves to presenting general considerations used in the selection of materials for use in various parts of a centrifugal pump.

Some of the factors which enter into the selection of the most suitable materials are: (a) Corrosion resistance, (b) electrochemical action, (c) abrasiveness of any suspended solids, (d) pumping temperature, (e) head per stage (as it affects both the impeller peripheral velocity and the liquid velocities in the waterways), (f) operating pressure, (g) suitability of the material to the structural features of the particular pump involved, (h) load factor and expected duration of the pumping installation.

Our first analysis will concern itself with the separate parts which comprise a centrifugal pump and with the materials most commonly used for each of these parts shown in Fig. 1 and 2.

### Pump Casings

Centrifugal pump casings are usually made of cast iron. However, a cast iron casing of a given design will be suitable for only a definite pressure limit. If higher pressures are encountered (either through operation at higher than design speeds or because of an abnormally high suction pressure), then either the design must be modified to obtain greater strength or a stronger metal, such as cast steel, must be substituted for the cast iron.

Occasionally, pumping systems are subjected to water hammer or shock pressures far in excess of the normal operating pressures and a stronger metal is necessary.

While theoretically it is possible in some cases to use a cast iron casing under high pressure, the thickness of metal required would not be satisfactory from the point of view of foundry practice. In some cases, substitution of thinner cast steel sections for heavy cast iron casings may compensate the higher material cost, almost to the point where use of cast steel is the more economical solution. While each design of centrifugal pump has its own pressure and temperature limitations, there is an upper limit where practical and economic reasons dictate the use of steel regardless of pump design. Thus, cast iron casings are seldom used for pressures over 1000 psi and temperatures over 350 deg F.

Cast iron loses tensile strength and becomes quite brittle at low temperatures. For this reason, in pumps handling liquids (such as brine) at very low temperatures the pump casing is generally made of alloyed cast iron or cast steel.

Bronze is frequently used for pump casings when the liquid pumped is mildly corrosive, as for instance, sea or harbor water. Stainless steel casings are used when the pumped liquid is corrosive. Porcelain or glass casings are sometimes used for very special applications.

### Impellers

Bronze impellers are generally preferred when handling average waters because bronze is easier to cast when complicated cored sections are involved, it is easier to machine, smoother surfaces can be obtained and finally, because bronze does not rust. However, it is not desirable to use bronze impellers with cast iron casings if the liquid handled is a strong electrolyte. In such cases, all ferrous materials should be used.

When heated, bronze expands approximately 40% more than steel. Since pumps are assembled at normal room temperature, the original radial clearance between the hub of a bronze impeller and a steel shaft will increase under operating conditions if the pumping temperature is above normal. This increased clearance can act to loosen the impeller on the shaft and introduces the possibility of leakage and erosion. In addition it must be remembered that the impeller assembly must be held axially by means of shaft nuts or shaft sleeves which themselves are fixed on the shaft by means of external nuts. If the axial assembly is made tight under cold conditions, the unequal expansion of the impeller hub and of the shaft will cause "crushing" of the bronze impeller hub and may even set

**TABLE 1—MATERIALS USED FOR PUMP PARTS**

| Part | Standard Fitted Pump | All Iron Pump | All Bronze Pump |
|---|---|---|---|
| Casing | Cast iron | Cast iron | Bronze |
| Suction head | Cast iron | Cast iron | Bronze |
| Impeller | Bronze | Cast iron | Bronze |
| Impeller ring | Bronze | Cast iron or steel | Bronze |
| Casing ring | Bronze | Cast iron | Bronze |
| Diffuser | Cast iron or bronze | Cast iron | Bronze |
| Stage piece | Cast iron or bronze | Cast iron | Bronze |
| Shaft (if sleeve used) | Steel | Steel | Steel, bronze or Monel |
| Shaft (if no sleeve used) | Stainless steel or steel | Stainless steel or steel | Bronze or Monel |
| Shaft sleeve | Bronze | Steel or stainless steel | Bronze |
| Gland | Bronze | Cast iron | Bronze |

NOTE: Materials for bearing housings, bearings and other parts are not generally affected by the liquid handled.

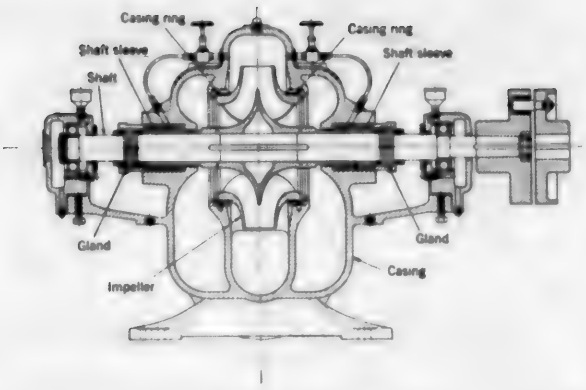



Fig. 1. Section of a double-suction single-stage pump with shaft sleeves.

up severe stresses in the shaft itself. If the assembly is made so as to be tight under operating temperature conditions, the impeller will be loose at low temperatures and there is no possible provision to hold it in accurate axial alignment until the pump becomes heated.

Finally, if there are changes in the operating temperature, it would be impossible to keep the assembly tight at all temperatures without setting up excessive stresses.

These possibilities are removed when materials are chosen such that the expansion of the shaft, impellers, and sleeves is equal. For these reasons, bronze is generally not used for pump fittings whenever the temperature of the pumped liquid exceeds 250 deg F.

### Wearing Rings and Shafts

Wearing rings are usually made of bronze for the same reason as the impellers. However, cast iron, cast steel, stainless steel or monel rings are sometimes used, regardless of whether the impeller itself is made of bronze or of another metal. Such metals are used when hardness or other properties unobtainable with bronze are required.

In pumps where shaft sleeves are used, shafts are generally made of open hearth steel. When high stresses are to be encountered, preference may be given to high tensile strength alloy steels. When corrosive liquids are handled, some seepage may occur either through the pores of the impeller hub or through the joint between the impeller and the sleeves thus requiring the use of a non-corrosive metal like stainless steel, phosphor bronze, or Monel metal. The shafts of pumps which are made without shafts sleeves are generally made of stainless steel, phosphor bronze, or Monel metal depending upon the liquid to be handled.

In the majority, shaft sleeves are made of bronze. When bronze sleeves are not satisfactory because of their relative low degree of resistance to abrasion, stainless steel is used. While a few years ago, steel sleeves were more prevalent than stainless steel, the growing popularity and reduced cost of the stainless alloys has caused stainless steel to supersede ordinary steel and, in some services such as boiler feed, even bronze as shaft sleeve material.

A shaft sleeve which protects a shaft in a stuffing box must be made of a material that can be given a smooth finish so it will operate properly in conjunction with the packing. Thus cast iron is rarely used for shaft sleeves.

Glands are generally made of bronze, although cast iron or steel may be used for all-iron fitted pumps. Where pumps are handling inflammable liquids, iron or steel glands are bushed with bronze to avoid possible sparking.

### Pump Fittings

The expression pump fittings is used rather loosely to mean two entirely separate things. In the most accepted sense, it refers to the general construction features of the pump, as for example "ball bearing fitted pump," or to the combination of materials used in the pump, as in "all-iron fitted pump." In a different category (such as when applied in the expression "underwriter fittings"), it may refer to various pieces of auxiliary equipment, such as valves, gages or even tools.

### Standard Fitted Pump

The so-called standard fitted centrifugal pump as defined by the Hydraulic Institute is bronze fitted. It has a cast iron casing, steel shaft, bronze impeller and wearing rings and bronze shaft sleeves, when used. Some manufacturers regularly furnish stainless steel shafts on pumps without shaft sleeves as standard fitted pumps.

Various centrifugal pump manufacturers have developed specific material selections for pumps designed for special services. When a pump is so constructed it is generally termed as a "standard pump" although reference is sometimes erroneously made to "standard fitted pumps," even though the materials used may not correspond to the Hydraulic Institute definition.

When all parts of a centrifugal pump which come into contact with the liquid pumped are made of bronze, the pump is considered to be an all-bronze pump.

When all parts of a centrifugal pump which come into contact with the liquid pumped are made of iron or of ferrous metals, the pump is considered to be an all-iron pump. Materials for parts in standard, iron, and bronze pumps are listed in Table 1.

An acid-resisting pump is such that all parts of the pump in direct contact with the liquid pumped are constructed of materials which will offer the maximum resistance to the corrosive action of the liquid.

### Salt Water Pumps

Centrifugal pumps handling salt or sea water may be built with standard fittings, that is cast iron casings and bronze trim, in all-iron, in all-bronze or with iron casings and stainless steel fittings, depending on a number of factors.

Thousands of standard fitted pumps are in use handling sea water, but occasionally that type is not suitable, mostly when the sea water is contaminated as is the case with harbor waters. Failures are usually due to galvanic action between the bronze parts and the cast iron casing which accelerates the graphitization of the casing. The worst damage occurs in the high velocity areas. Under high suction lift conditions, galvanic action is accelerated due to the release of oxygen from the water.

While an all-iron pump avoids the electrolytic action between bronze parts and cast iron casings, such action may occur nevertheless. A certain amount of iron dissolution may take place, leaving graphitized areas. These areas

perform as cathodes to the untouched anodic parts of cast iron and the resulting galvanic action is self-accelerated.

To avoid the graphitization and poor resistance to cavitation of cast iron impellers, these together with other small pump parts may be made of a proper stainless steel.

In general, an all-bronze pump should give the longest life for sea water conditions and instances are recorded of all bronze pumps lasting over 20 years handling sea or harbor water. Some harbor waters are contaminated by chemicals which make bronze unsuitable.

The pH value of a liquid is a quantitative representation of the relative acidity or alkalinity of a liquid. A solution having a pH of 7.0 is neutral, pH values above 7.0 indicating alkalinity and pH values below 7.0 indicating acidity. Since the pH value is expressed in a logarithmic scale, it must be remembered that changes in pH represent more than a direct linear change. For instance, a solution having a pH of 5.0 is ten times as acid as one having a pH of 6.0.

The pH of a given solution varies somewhat with temperature changes, decreasing rather rapidly up to 300 deg and remaining fairly constant above that. For instance, a solution with a pH of 8.5 at 70 deg will have a pH of about 7.0 at 300 deg and 6.8 at 500 deg.

While pH is not the only factor influencing the selection of materials of pump parts, it may be stated that standard bronze fitted pumps should not be used for pH below 6.00 or above 8.5 at the pumping temperature. Below 6.00, the all-bronze pumps or stainless steel fitted pumps should be used, while above 8.5, the pumps should be all-iron or stainless steel fitted. For very acid or very alkaline solutions, stainless steel alloys only shoud be used.

### Galvanic Corrosion

When two dissimilar metals are used in close proximity, in a pump handling a liquid which is an electrolyte, severe corrosion may occur due to the galvanic cell action between the two metals.

Galvanic corrosion is a corrosion of a metal which occurs when the metal is electrically connected to a dissimilar metal in corrosive conditions. The combination of the two metals connected with each other and immersed

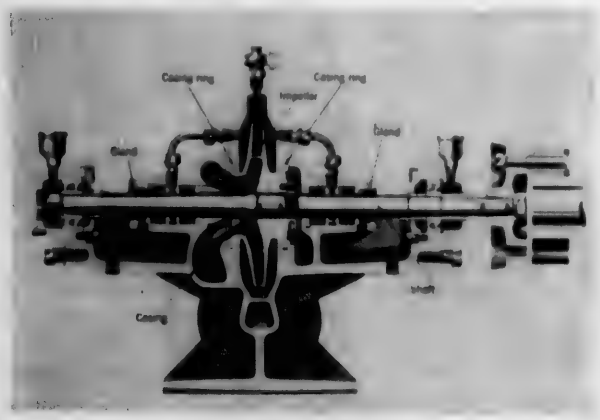



Fig. 2. Section of a single-suction, single-stage pump without shaft sleeves.

**TABLE 2—GALVANIC SERIES OF METALS COMMONLY USED IN CENTRIFUGAL PUMP CONSTRUCTION.**

| | |
|---|---|
| Corroded | End (Anodic) |
| | Zinc |
| | Iron |
| | Low Chromium Iron or Steel (Active State) |
| | Low Chromium Nickel Iron or Steel (Active State) |
| | Tin |
| | Lead |
| | Brasses |
| | Bronzes |
| | Copper |
| | Nickel-Copper Alloys |
| | Low Chromium Iron or Steel (Passive State) |
| | Low Chromium Nickel Iron or Steel (Passive State) |
| | Monel |
| Protected | End (Cathodic) |

in an electrolytic solution is the simplest form of an electric battery cell. The electro-chemical reaction set up under those conditions causes electric current to flow from one metal to the other, and one of the metals goes into solution in the liquid pumped. The protected metal is the cathode and the corroded end is the anode of the two-metal cell.

If metals are arranged in the order of their polarity toward one another in galvanic action, the resulting tabulation is termed a galvanic series.

The galvanic series presented in Table 2 gives an approximate idea of the interrelation of metals most commonly used in centrifugal pump construction. It does not include the various high chromium or chromium nickel stainless steels used for pump parts as the position of these alloys in the series cannot be definitely fixed and has been known to change depending on the exact nature of the electrolyte. They will occupy a position in the iron and low chrome iron group and the galvanic action between these materials is almost negligible.

The relative position of the metals listed in each group is subject to some changes. However, changes between adjoining groups of metals are unusual.

### Effect of Structural Features

While in many cases, the choice of materials can be made mainly from the point of view of corrosion and abrasion resistance, the structural features of a given pump part may play a definite role in the final material selection. Some parts, for instance, may require extremely thin wall sections and a material such as cast iron would prove to be unsuitable for these parts, even though it may be suitable from the point of view of corrosion. Other parts, such as shaft sleeves, require a high degree of polish and only materials which are capable of receiving such finish can be used for these parts.

Wherever the structural design features require the use of pressed-on or shrunk-on parts, the material used for these parts must be suitable for this method of mounting. For instance when pump impellers have to be shrunk on the shaft, bronze cannot be used and the selection is restricted to cast steel or stainless steel.

One of the important factors in the strength of metal castings is the relative uniformity of cross-sections of various portions of the casting. The more uniform these cross-sections, the stronger will be the casting and the less will be the possibility of internal cracks, inclusions, etc.

### Effect of Load

It is obvious that the selection of metals which would give the longest possible life for a temporary installation would be very uneconomical. Thus, frequently a standard fitted pump is applied on a service where corrosion or erosion will wear the pump out in relatively short time, since the need of the pump is shorter than its life on the service. The same reasoning applies to installations where the pump is operated an extremely small percentage of the time, as long as contact with the liquid pumped during the idle periods does not continue the disintegration process or as long as the pump can be drained and flushed out.

In other words, plain common sense dictates that the choice of materials be based on considerations of optimum economic life, that is on the selection of such a combination that the initial cost plus the cost of possible replacement parts yields the lowest overall total investment during the expected life of the equipment. Thus in many instances, the choice of materials will be neither the cheapest nor the most expensive which may be available.

On the other hand, where outstanding reliability is desired, the best materials are none too good, even if a pump is to operate but once in ten years. The best example of this statement is that of the pumps used in the U. S. Navy. While operation of the centrifugal pumps on board ship is relatively infrequent in peacetime and not all the equipment installed is operated constantly even in war time, the most rigid specifications as regards materials are enforced by the Navy since failure of any part of the equipment may prove disastrous. The same considerations apply to pumps used on fire service, where dependability is of paramount importance.

---

## Globe Chemical Among First to Use Plastic Piping For All Acids

***(A Product Application)***

The Globe Chemical Company, Cincinnati, is among the first large scale handlers of highly corrosive liquids to switch from metal to plastic piping for all services. Globe's plastic is polyvinyl chloride (PVC), which was selected after laboratory and field tests indicated that it was the most suitable material. The tests also established that the use of PVC would drastically reduce the company's heavy piping maintenance costs. Globe is a major distributor of acids, solvents and chemical compounds. Tank farms and loading facilities are located in Cincinnati, Dayton and Louisville The new piping conveys mainly 77-96% sulfuric acid, 61.4% nitric acid, 37-38.5% muriatic acid, 75-85% phosphoric acid and 99-½% glacial acetic acid. Temperatures are atmospheric and pressures do not exceed 100 psi. The piping ranges from 1¼-inch through 2-inch and was fabricated with unplasticized injection molded screwed fittings produced by Tube Turns Plastics, Inc., Louisville, Ky.

The company formerly employed carbon steel, wrought iron, Type 304 and Type 316 stainless steel, aluminum and lined piping, which was also screwed. Failures occurred at 3 to 12 month intervals. The failures necessitated replacement of part or all of the piping, often created formidable hazards and interfered with scheduled operations. Leakage proved costly. Scale reduced I. D dimensions as it accumulated, and created pressure losses. Year after year, piping maintenance continued to represent a substantial percentage of overhead. In addition, there had to be a perpetually large inventory of pipe and fittings in a variety of metals and alloys so that piping failures could be promptly remedied.

Globe began using PVC piping last September and the change-over is about 75% completed.

R. C. Grote, Globe's treasurer, and J. S. O'Hair, who has charge of laboratory and operational activities, recently listed these marked advantages brought about by the adoption of PVC:

(1) The cost of PVC piping and screwed fittings is much less than comparable pipe and fittings of the metals and alloys previously used.

(2) There have been no failures and the piping shows no signs of deterioration. Thus the expense of replacing pipe at short intervals, formerly unavoidable, has been eliminated

(3) Since PVC will satisfactorily carry all of Globe's acids in all the concentrations the company employs, a large inventory of piping is no longer required. And the considerable area once needed for pipe storage is released for other purposes.

(4) The waste of products that occurred when metal and alloy piping failed has been stopped.

(5) Hazards of leakage caused by corrosion have been eliminated.

(6) With piping failures a thing of the past, there are no unscheduled shutdowns.

(7) PVC piping is easier to install and disassemble, light in weight, unaffected by weather, non-aging and has excellent electrical and insulating properties.

(8) PVC piping requires no paint, and its external surface is as resistant to corrosion as its internal surface. The former is particularly important, since more than 50% of Globe's piping is on the outside and much of it is subjected to acid fumes.

(9) Since scale is no longer present, Globe's reagent and technical grades of acids are completely protected against discoloration and contamination. Formerly, metal and alloy lines hd to be carefully flushed out before start up time in order to assure high purity products.

(10) The PVC fittings employed—made by the Hendry process for injection molding—are appreciably stronger than PVC fittings made by conventional compression molding processes, on a strength to weight basis.

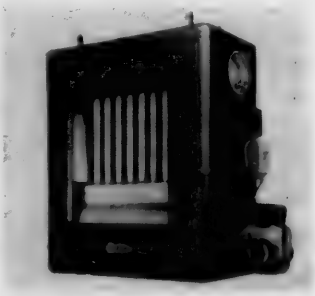
Tube Turns Plastics, Inc, the only manufacturer of injection molded PVC fittings for commercial applications, is owned jointly by the National Cylinder Gas Company, Chicago, and Jackson & Church Company, Saginaw.

# NEWS OF EQUIPMENT AND MATERIALS

**Use the convenient prepaid postcard on page 140 for securing additional information on items described in this department.**

## Heaters Fit Cooling Ducts

Oil-fired duct heaters, in five capacities are made by Delta Heating Corp., Trenton, N. J., for installation in air-cooled ducts. Available for use with a remote operated air-cooling unit, the heaters have inlet and outlet sides that are flanged for attachment to the air carrying ducts. Their oil burner is interchangeable to either right or left side, and the flue outlet can be attached to either side of the heater.



The largest of the five sizes, the Model UHD220, has an output of 200,000 Btu per hr, an output equivalent to 900 sq ft of steam. The smallest size heater has an output of 112,000 Btu per hr, or approximately 460 sq ft of steam radiation. Various outlet air temperatures are available from the heaters to fit different buildings' needs. Short stacks and flue pipes will not affect the efficiency of the heaters inasmuch as they are designed to operate with drafts as low as .01 inches of water.

Literature and selection charts are available from the manufacturer.

**More information? Circle Item 1 on postcard, page 140.**

## Motor Frames Are Re-Rated

General-purpose, ball bearing, polyphase motors, in re-rated NEMA frame sizes 182 through 326, are announced by Wagner Electric Corp., St. Louis, Mo. Designated type DP, the motors with corrosion-resistant cast iron frames are suitable for indoor or outdoor use. (A 5-hp motor with a No. 215 frame is illustrated in the photograph.)

To protect the motors from moisture, ventilating air intakes are located at the bottom of the endplates and air outlets are positioned at the base of the frames on each side. Baffle plates direct air into the blowers and through the motor to provide extra protection for the stator windings.

Provided with means for relubricating the bearings when necessary, the motors will be available in 1 to 30-hp ratings, 3 phase, 60 cycles, 1750 rpm. Bulletin MU-202 describes their construction features in detail.

**More information? Circle Item 2 on postcard, page 140.**

## Cord Set for Room Coolers

A flexible cord set for room air conditioners has been developed by Accessory Equipment Dept., General Electric Co., Bridgeport, Conn.

Made of thermoplastic insulating material, the cord set is similar in appearance to the rip-cord type but differs in that the green grounding conductor is nested between the other two conductors. When the cord is ripped, the green conductor becomes exposed. The set is also available in a two-conductor model for non-grounding applications.

Approved by Underwriters' Laboratories, the cord set is available in 14 and 16 AWG-sizes for room air conditioners. A plug has also been designed especially for the set.

**More information? Circle Item 3 on postcard, page 140.**

## Flush Case For Switches

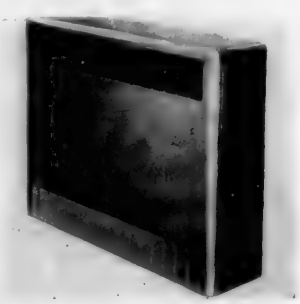
A flush-type switch case (NEMA Type 1B) is available from Tork Clock Co., Mt. Vernon, N. Y., for use in finished installations where all enclosures and wiring are to be concealed behind the wall. The cases can be installed near or in show windows, for example, so that control equipment is always accessible for inspection.

Switches for the control of heating, air conditioning, or lighting in department and retail stores, office buildings, apartment houses, or institutions can be housed in the cases.

**More information? Circle Item 4 on postcard, page 140.**

## Cabinet-Type Unit Heaters

Cabinet-type unit heaters have been designed by C. A. Dunham Co., Chicago, Ill., manufacturer of heating and cooling equipment. The heaters have the heating capacity of a unit heater and the appearance of a convector.



Available in seven different styles, they can be floor-mounted, vertically wall-mounted, partially or fully recessed, or concealed and serviced by ductwork.

Their cabinets have rounded corners and edges, and their fronts are made of heavy-gage steel, reinforced with stiffener strips. The heaters' 2-speed motors are mounted in rubber for quiet operation, and the blower fans are mounted directly on the double-end shaft of the motor.

The entire fan assembly is removable in one piece.

**More information? Circle Item 5 on postcard, page 140.**

## All-Metal Indicating Extension

A non-magnetic metal extension tube replaces the customary glass tube in the Mag/Na/Vue which has been developed by Brooks Rotameter Co., Lansdale, Pa., mainly for use with the Ar/Met Armored Rotameters. The unit is designed for use at pressures to 1200 psi at 200 deg. F, or for metering opaque fluids.

Riding inside the extension is a float with a permanent magnet imbedded in the float head. Outside the extension, a light-weight indicating sleeve moves in response to any change in float position. The magnet in the float head holds the sleeve to the float position. Since there are only two fine edge contact points and the extension tube is satin-chrome finished, virtually no friction exists.

The extension is sealed in place by a tubing connector integrally machined as a part of each end fitting. No O-rings or rubber packings are required.

More information? Circle Item 6 on postcard, page 140.

## Convectors Are Custom-Made

A custom-made convector system for steam and hot water heating has been developed by Warren Webster & Co., Camden, N. J. Called Custom Webster Walvector, the system has been designed so that it would become an integral part of the building in order to reduce its cost. Eight basic types of the convector are available. Its heating element is standard copper tubing with aluminum fins, in 3 or 4-in. sizes. Enclosures are custom-made for the convector to required dimensions, of No. 16 gage steel with internal support braces. They are available for wall mounting or with an integral sill; with either a front outlet or top outlet; and for a single or double row heating element. For wall-to-wall application, separate enclosure units are joined by an internal support made of 12-gage steel. This provides both the support and the junction of the enclosures. Intermediate braces are used to increase rigidity.

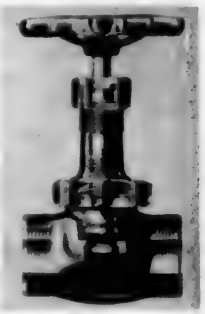
The enclosure's front and top are in one piece, with grille arrangements that permit the placing of furniture against the enclosure without interfering with the flow of heated air. Wall-hung enclosures utilize a wall support strip with a sponge rubber gasket for sealing the space between the enclosure and the wall to prevent dirt streakage. Top outlet units are used under windows or where wall streaking cannot occur.

Where required, each section can be provided with a factory-assembled knob-operated damper of the modulating type, which can be set in any position from closed to fully open.

More information? Circle Item 7 on postcard, page 140.

## Flat-Seat Throttling Valve

A bronze globe valve, No. LQ600, for throttling service is introduced by The Lunkenheimer Co., Cincinnati, Ohio. The company announces the valve after a 4-year test program during which the valve was installed in problem installations of various companies.



Two design features distinguish the valve from the company's previous models. One is the seating metal, which is patented by the company under the name of Brinalloy. A uniformly hardened alloy, the seating metal resists wear and corrosion to a greater extent than 500 Brinell stainless steel or case-hardened stainless steel exceeding 1000 Brinell.

The other feature of the valve is its flat-seat design. The flat seat can be used for the throttling valve because the seating metal reduces the wear due to wire-drawing effects.

The valve is equipped with the company's stem, handwheel, and body and bonnet bronzes.

More information? Circle Item 8 on postcard, page 140.

## Filter Pack Is Stamped

An aluminum air filter medium that has its air openings stamped to a predetermined tolerance is made by The George Evans Corp., Moline, Ill.

Each filter of the same size has the same number of openings; for example 76,060 in a 20 x 20 x 2-in. filter.

This control of size, shape, and position of the air scoop opening makes it possible to have larger openings on the inlet side progressing to smaller openings on the outlet side of filter medium.

More information? Circle Item 9 on postcard, page 140.

## Combination Tester

A combination tester for checking thermocouple output and temperature is offered by Robertshaw-Fulton Controls Co., Youngwood, Pa.

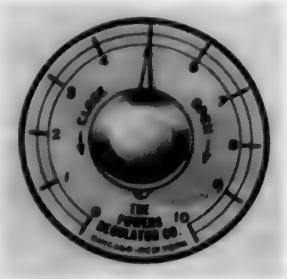
Named Model No. 32-JP-4-MV, the tester is designed for checking the milli-voltage output of single or multiple thermocouples in both open and closed circuits with ranges from 0-50 or 0-1000 mv. It will also check temperatures, within the range from room up to 650 deg F, of water heaters, ovens, dryers, heat treating installations, and other commercial and home appliances. The instrument automatically compensates for changes in ambient temperature.

The binding posts on the instrument are color-coded to prevent errors in connecting lead wires. Its packed weight is approximately 3 lb 3 oz.

More information? Circle Item 10 on postcard, page 140.

## Pneumatic Switches

Pneumatic switches designed for the remote control of diaphragm valves or damper motors are available from The Powers Regulator Co., Skokie, Ill. The switches are suitable for either surface or flush mounting, with ⅛-in. NPT connections for supply pressures to approximately 25 psi.



A gradual switch (illustrated) made by the company is actually a reducing valve; clockwise movement of the pointer from 0 to 10, on the dial, gradually increases delivery pressure to 15 psi. Positive-acting diverting switches are built with 2, 3, or 4 ports, and with a variety of standard engraved dials.

Additional information on the switches is contained in Bulletin 357, published by the company.

**More information? Circle Item 11 on postcard, page 140.**

## Air Conditioners Made Lower

Floor-type commercial package air conditioning units, featuring lower overall height, are available from American Blower Corp., Detroit, Mich. The self-contained air conditioners are available in 3, 5, 7½, 10, and 15-ton sizes for installation in restaurants, banks, schools, hotels, hospitals, public buildings, and institutions.

With discharge plenums, the units are approximately 8 in. shorter in height than conventional units having comparable capacities. Reduced height is made possible through the use of two cold flow diffuser grille sections containing curved blades which direct the cold air up and away from the conditioner. Even though the diffuser grille height is less than 6 ft, the curvature of the blades eliminates objectionable direct cold air flow at head height. In addition, the blades impart a turbulent, swirling motion to the cooled air as it leaves the conditioner in order to speed the diffusion of air to the conditioned area.

The low height permits the 3 and 5-ton sizes to be shipped assembled in one piece and ready for installation.

The air conditioners have a water-cooled condenser and a heavy layer of fiberglas insulation. The insulation also functions as a sound deadening medium.

Finished in leathertex tan, the units blend with colors and interior decorating patterns; their surface can be cleaned with mild soap and water. All their exposed corners are rounded for safety and cleanliness.

For heating, the packaged units can be provided with steam or hot water coils.

The four-section units are designed to permit individual removal of any section front panel by loosening screws. Removal of the front panel permits access to the working parts for maintenance and service. The upper, or plenum, section can be omitted where a direct duct installation is desired.

Condensate from the units is permitted to drain into a drip pan which is provided with an external drain connection, and deflectors on the cooling coil prevent the condensate from dripping on the standard throw-away filters. Return air thermostats are standard equipment of the 3, 5, and 7½ ton sizes.

**More information? Circle Item 12 on postcard, page 140.**

## Plastic Packing

A Teflon plastic packing, Flexrock 403, for centrifugal applications has been developed by Mechanical Packing Div., Flexrock Co., Philadelphia, Pa.

The packing is composed of shredded Teflon combined with binders and lubricants, extruded into an open cotton yarn jacket, and impregnated with graphite. It is also available impregnated with mica for use wherever a non-contaminating packing is essential. It is chemically inert and will not be attacked by organic or inorganic acids, alkalies, or solvents.

Serviceable from —150 to 550 deg F it can be used on valves, pumps, and agitators. The packing is installed by cutting it in necessary lengths, coiling it around the shaft, and placing it into the stuffing box. It is available in sizes from ¼ to ¾ in. in increments of 1-16 in.

**More information? Circle Item 13 on postcard, page 140.**

## Casters for Room Coolers

The development of a line of adjustable casters, called Scruswiv, to compensate for uneven floor surfaces and provide stability as well as portability for home air conditioners is announced by Adjustable Caster Co., Philadelphia, Pa.

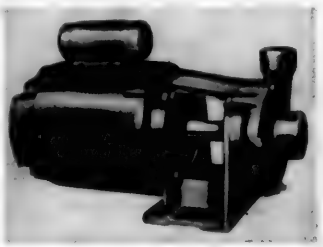
Available for installation in metal, wood, tubing, or angle irons, the casters are levelled to correct high and low spots that occur in floors by turning an adjusting nut with the fingers. Along with the finger adjustment is a locking adjustment that prevents turning of the adjusting nut when subjected to vibrations from motorized equipment, such as portable room air conditioners.

The casters are available both to manufacturers, for use on original equipment, and to servicemen, for installation and conversion on equipment already in use.

**More information? Circle Item 14 on postcard, page 140.**

## Fractional Horsepower Pumps

A series of fractional horsepower centrifugal pumps is added to the line of A. Y. McDonald Mfg. Co., Dubuque, Iowa.



The pumps are single-stage, single suction, enclosed impeller models designed for handling capacities to 70 gpm and for heads to 85 ft. The company designates this series of its pumps as Figure 7720.

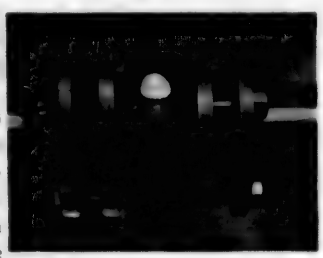
Built for positive operation, the pumps can be used either intermittently or continuously. They are designed for horizontal, vertical, or angular mountings and are intended by the company for air conditioning and booster pump service.

Five sizes are included in the series: ¼, ⅓, ½, ¾, and 1 hp.

**More information? Circle Item 15 on postcard, page 140.**

## Rubber Expansion Joints

Rubber expansion joints, No. 209, designed for use with piping and flanges made by Haveg Corp., (as illustrated), and The Duriron Co., Inc., are announced by The Garlock Packing Co., Palmyra, N. Y.



The expansion joints are made of a high-grade rubber compound combined with plies of cotton duck and reinforced with steel wire. Steel rings are used in the flange ends of the joint to permit tightening of the connections without shearing the expansion joint.

The company can supply special expansion joints for various services, with a Neoprene lining if some oil is present in the line; with a Neoprene cover and Neoprene lining if, in addition, the outside of the joint is in contact with oil; with Neoprene throughout if the line carries petroleum derivatives; and with a Teflon liner if the line carries liquids or gases harmful to rubbers.

The expansion joints are furnished for pipe sizes from 1 to 12 in. inclusive. Complete information concerning them is contained in Folder AD-137.

**More information? Circle Item 16 on postcard, page 140.**

## Absolute Pressure Control

The Type J20 control, manufactured by United Electric Controls Co., Watertown, Mass., utilizes an evacuated bellows to provide switching action in response to source pressure variations independently of atmospheric pressures and temperatures. The device is used to control the action of pressurizing pumps when absolute pressures must be maintained on air-borne, mobile, or other equipment. It has been used in numerous applications in stratospheric conditions, in pressurized coaxial cables, in ground radar, and in maintaining frequency bands.

The bellows is spring loaded to insure its response to pressure variations. The expansion or contraction of the bellows, due to changes in pressure, actuates a snap-acting switch. The control can be factory set between the range limits of 0 to 35 psia with a differential choice between the limits of 1.5 and 5.0 psia. The control has an adjustable range of 5.0 psia and a repeat accuracy of 0.1 psia between minus 65 to plus 160 deg F, altitude to 60,000 ft, and 100% relative humidity.

The single-pole, single-throw, snap-acting switches used on the control are rated at 4 amps with a non-inductive load at 28v d-c or 10 amp at 115v a-c. The class-R switch is normally closed and opens on decreasing pressures. The class-G switch is normally open and closes on decreasing pressures.

The control measures 3-5/32 x 2-11/32 x 1-3/32 in., is mounted by means of a ⅛-in. NPT male fitting, and the electrical connection can be soldered in any desired position to rotating solder terminals on the face of the control.

**More information? Circle Item 17 on postcard, page 140.**

## Liquid Gage for Pressure Tanks

A dial-type, hydrostatic, remote-reading, tank gage, known as the Levelux Fuelmaster, for use on pressurized tanks or tanks that operate under vacuum, has been developed by Liquidvision Gauge & Control Corp., Oceanside, N. Y. The gage is equipped with a 12-in. dial that has large graduations and a pointer travel of approximately 30 in.

It is bellows actuated and uses two lines to the tank; one is connected with an airbell and the other, an equalizing line, is connected to the vapor space. In operation, the pressure responsive element is a bellows, the motion of which varies with the head of liquid in the tank. The motion of the bellows is conveyed out of the indicator housing by a magnetic coupling that actuates the pointer through a sector and gear. This patented feature makes it possible to use the gage on any tank, regardless of how high the pressure may be. It also can be used on tanks that operate under alternate pressure and vacuum, and is automatic in operation when actuated by a continuous air supply.

Dials can be furnished graduated in any unit of liquid measure and, where it is desired, luminous treatment can be applied both to the graduations and tank legends. Two-scale dials are also available.

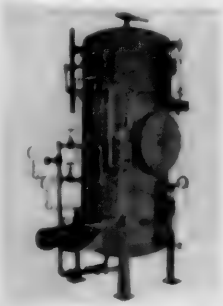
The indicator case has a black wrinkle finish and is furnished for wall or panel mounting.

Another feature of the gage is that it has an external zero resetter so that it is not necessary to open the indicator case to check and reset the zero. Nothing is required within the tank except a suitable length of pipe or tubing for an air chamber.

**More information? Circle Item 18 on postcard, page 140.**

## Hot Water Heating System

A hot water heating system, called Iso-Therm, that will provide constant temperature hot water with a minimum amount of boiler horsepower is manufactured by Fred H. Schaub Engineering Co., Chicago, Ill. It does this by utilizing a patented technique of constant average steam feed with offset cooling water temperature control.



The heater is a direct-steam-mixing type that requires no return line. The tank is protected from corrosion by the company's Chromasoid lining and a magnesium electrolytic corrosion inhibitor. It is guaranteed for ten years against corrosion.

Designed for small laundries, feeder plants, and dairies, the packaged hot water heating system is available for hot water loads up to 900 gph. Non-packaged designs are available for loads up to 20,000 gph.

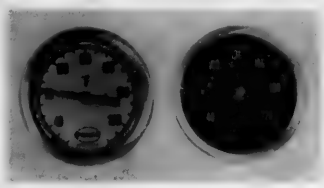
Bulletin No. 920-A gives complete information on the system.

**More information? Circle Item 19 on postcard, page 140.**

## Thermometer Dials Contrast

On-sight temperature readings are claimed for a series of dial thermometers manufactured by Precision Thermometer and Instrument Co., Philadelphia, Pa. The use of black and white contrasts in the dial faces are intended to improve reading of the dial thermometer.

Two color variations in the dial face are used. In one (right), the contrast is black on white with the degree graduations, numbers, and indicator in jet black on a white background. In the other (left), the contrast is white on black with the graduations, numbers, and indicator tip in white on a jet black background. All dial faces are 4 inches in diameter.



The thermometer itself is bimetallic and accurate to 1% of its range at any point of indication. Its stems are made of ¼-in stainless steel and come in standard lengths of 4, 6, 9, 12, 18, and 24 in for bottom or back connections. Separable sockets are available with the stems.

The 5-in dial case, made of pressure-cast aluminum alloy with a black crackle finish, is moisture proof and has a strong fume-proof bezel.

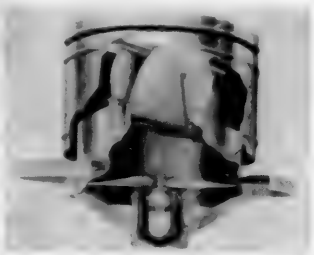
The linkage between the bimetal shaft and indicator shaft has bearings to minimize friction losses and sticking. Both pointer and scale can be set to any position desired through full 360 deg rotation. This permits the reading axis to be made vertical at 12 o'clock regardless of the position of the instrument. The dial thermometers can be installed vertically, or on the right or left side of equipment, as side form angle thermometers.

**More information? Circle Item 20 on postcard, page 140.**

## Emergency Damper Opener

A thermally-actuated emergency damper opener for its Sky-Blast power roof ventilators is offered by Propellair Div., Robbins & Myers, Inc., Springfield, Ohio.

The unit is designed to allow the roof ventilator to serve as a venting device for smoke, heat and fumes in the event of fire. This has been a particular problem in modern one-floor buildings where smoke quickly spreads radially, preventing firefighters from getting to the source of the blaze.



Consisting of twin high-torsion, alloy steel springs, mounted on a telescoping steel tube support, the device is independent of electrical equipment which might be damaged by fire or water. It uses no motors, thermostats, wiring, or counterweights. The two steel spring arms are held in place by a fusible link which breaks when the pre-selected critical temperature is reached; the arms then open the dampers (illustrated) to provide an unobstructed escape route for smoke and fumes. The device functions independently of fan operation.

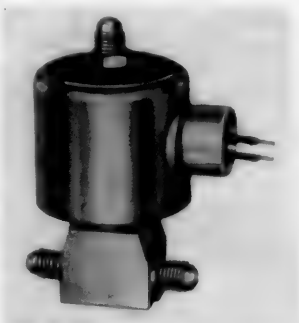
The unit is available in two sizes for roof ventilators from 24 to 60 inches in diameter. A range of temperature ratings is available, permitting the selection of the rating best suited for a particular application. The ratings range from 135 to 360 deg F.

On roof ventilators already in service, the device can be installed with eight bolts.

**More information? Circle Item 21 on postcard, page 140.**

## Control Has SAE Connections

By using ¼-in SAE male flare connections, Sporlan Valve Co., St. Louis, Mo., has modified its Type 171 solenoid pilot control. The modified control is designated Type 172 to distinguish it from the now obsolete Type 171.



The control is used in place of large capacity solenoid valves for positive shut-off of liquid lines and is available for Freon-12, Freon-22, Carrene-7, and methyl chloride. It does not directly close the liquid line, but acts on the thermostatic expansion valve causing it to close.

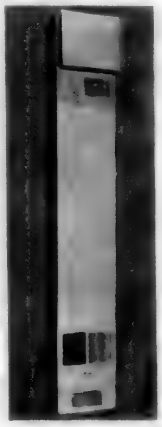
Any number of thermostatic expansion valves, as large as those nominally rated at 50 tons on Freon-12, can be connected to one control, thus simultaneously controlling the action of one valve or the entire plant.

Additional information about the solenoid pilot control is contained in Bulletin 30-70.

**More information? Circle Item 22 on postcard, page 140.**

## Counterflow Wall Heater

Its latest development in gas-fired heating equipment, the Williams Forsaire, is announced by Williams Furnace Co., Glendale, Calif. The equipment is a wall heater that employs the principle of counter-flow, forced warm air circulation. Warmed room air is salvaged, pulled in at the top of the unit by an 8½-in. dual inlet blower, forced down over the heating element, and out through diffuser type grilles to the floor.



Measuring 14 in. in width, 7 in. in depth, the unit can be recessed between 2 x 4, or larger, studs on 16-in. centers. AGA approval for zero clearance on the back and sides allows the unit to be installed against a wall or as a free standing heater. Single or dual heat outlets can be provided without the use of ducts. An electric connection, ½-in. outlet, and a short vent are all that are necessary for installation.

The heater is automatic in operation and factory-assembled with a blower, limit control, an automatic valve and a wall thermostat. The heat exchanger has a split top design to provide more heating surface and is ceramic coated inside and out. The centrifugal blower has a multivane-type wheel, and its motor is rubber-mounted.

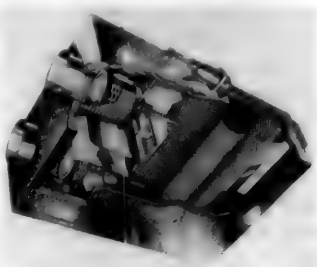
Designed as a heating system for homes, schools, offices, and other commercial installations, the unit is available in sizes from 50,000 to 63,000 Btu per hr input.

Detailed catalog information is furnished by the manufacturer on request.

**More information? Circle Item 23 on postcard, page 140.**

## Dual Duct Air Diffuser

Temperature and volume are controlled separately in a dual duct high pressure air diffuser made by Connor Engineering Corp., Danbury, Conn. While total air delivery, once established, remains uniform under operating conditions, temperature is varied in the diffuser by mixing hot and cold air quantities.



Both air inlets are fitted with dampers consisting of double perforated concentric sleeves and felt edged pistons. The two outer sleeves slide back and forth over the fixed inner sleeves, thereby governing the size of the holes through which the air flows. At extreme positions the perforations in one damper coincide, permitting maximum air passage, while those in the other damper are closed, blocking air passage. As both outer sleeves are moved simultaneously by the thermostat-actuated motor, the size of the holes in one damper increase in the same ratio as those in the other decrease, thus proportioning hot and cold air and controlling final temperature.

Adjusting the pistons changes the number of perforations accessible to the air flow and hence determines the total air delivery. Because each piston is adjusted separately, the hot and cold air supply can be regulated against different static pressures in each duct.

The sound levels of the diffuser, measured on the 40-decibel scale of a standard sound meter, range from 32 to 45 decibels, depending upon the size and type unit selected for a particular pressure and air delivery. Air volume is set by a rack and pinion, and mixing is obtained by 90-deg movement of a horizontal shaft, thus permitting the use of a standard damper operator controlled by a thermostat.

The dual duct diffuser, actually a combined valve and reducing chamber, is made in capacities up to 1000 cfm, operating at static pressures up to 6 inches of water.

**More information? Circle Item 24 on postcard, page 140.**

## Soft Soldering Flux Kit

A general purpose, soft-soldering, flux kit for engineers, designers, and production men is offered by Alpha Metals, Inc., Jersey City, N. J.

The kit contains a set of the most useful fluxes, including printed circuit, electronic, and general purpose fluxes. It enables a rapid determination of the proper flux for a soldering job and saves the trouble and time involved in acquiring samples.

There are sixteen fluxes in the kit, each one contained in appropriately labeled glass bottles. The flap of the carton has a chart showing each flux in its position in the carton.

**More information? Circle Item 25 on postcard, page 140.**

## Portable Ice Plant

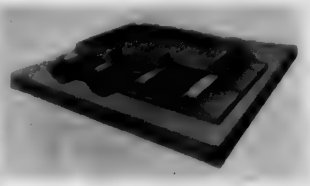
An ice plant, called the Shell-Ice Maker, that can be moved from one project to another has been developed by Frick Co., Waynesboro, Pa. The plant consists of a series of stainless-steel tubes, suspended vertically and cooled inside by the direct expansion of ammonia or Freon. Water is kept flowing down the outside of the tubes, its motion providing sufficient agitation to make clear ice.

Made of steel, the ice plant operates automatically and can be placed either near or at a distance from the refrigerating-machine room. It is being built in 12 sizes with capacities from ½ to 30 tons per 24 hours. (A 1-ton unit is illustrated.)

**More information? Circle Item 26 on postcard, page 140.**

## Two-Piece Filter Block

A re-designed two-piece filter block that eliminates hand placement of filter stone, is introduced by Straitsville Brick Co., New Straitsville, Ohio, as Ceramifilter. The two-piece block provides larger runoff channels and aeration openings and permits filter media to be deposited by clamshell.



Made from strong-burning fire clay, the lower channel blocks have 9/16-in. walls and center supports designed to withstand high stresses. The upper grill blocks are 3 in. thick and remain undamaged when filter media is loaded by clamshell. The upper grille blocks have eight openings totalling 44.3% of the total top area.

The channels' depth permits flat particles of filter media to fall clear of the upper block. Fiber paper strips placed in the drainage channels before the upper grill block and filter stone are deposited catch chips and flats which may fall through the grill opening. When the strips are pulled out, they carry the chips, flats, and fines out with them.

The blocks exceed the engineering requirements set up for filter floor service. They have a safety factor of ten times the strength required for the upper grill block and three times the strength required for the lower channel block by ASTM standards. The grill block opening area for aeration is 44.3% uncovered and 23% when the filter media has been placed with a clamshell. The lower channel blocks have 30½ sq in. of drainage area per foot of width.

**More information? Circle Item 27 on postcard, page 140.**

## Sweat Valve Is Added to Line

A brass sweat-type gate valve, designed for copper-tube installations, is added to the Milvaco line of valves by Milwaukee Valve Co., Milwaukee, Wis.

Termed Model 1145, the valve is a solder-type valve for working pressures of 125 lb steam, and 200 lb with water, oil, or gas; it is available in the following sizes: ⅜, ½, ¾, 1, 1½, 1¼, and 2 in.

The valve is recommended for home or industrial plumbing and heating systems. It has a non-rising stem and solid wedge disc construction.

**More information? Circle Item 28 on postcard, page 140.**

## Multi-function Control System

The development of Synchro-Scan, a multi-function supervisory control system, is announced by Builders-Providence, Inc., Providence, R. I.

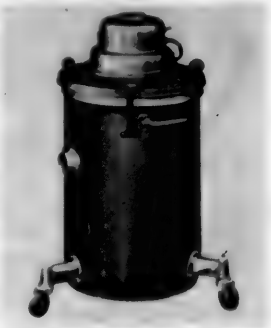
The system, utilizing a single pair of signal wires and supervised by one operator, permits remote control of combinations of pumps, valves, gates, generators, and circuit breakers from a central dispatching station. Its components also accomplish 2-way transmission of multiple telemetering and advisory functions, thereby furnishing the operator with information to supervise system operations and cope with almost any emergency.

The supervisory control is designed for simple installation and maintenance by local electricians and station operators.

**More information? Circle Item 29 on postcard, page 140.**

## Self-Cooling Cleaner Motor

A furnace cleaner, called Nu-Vac, is equipped with an independently cooled by-pass motor, for a small additional cost, by Empire Chemical Products Co., Newark, N. J.



The ⅞-hp motor develops 70 in. of vacuum. Water or dirt drawn into the cleaner will not harm the motor, since it does not depend on the exhaust air to keep it cool.

Weighing 25 lb, the cleaner is portable on rubber casters and holds over a bushel of dirt. Other features of it are an extra outlet for drop-light connections and a rayon bag to prevent tearing.

**More information? Circle Item 30 on postcard, page 140.**

## Two Power Ventilators

Two new types of roof ventilators have been designed to provide a wider selection of its power roof ventilating equipment in apartments, stores, factory and office buildings, by Ilg Electric Ventilating Co., Chicago, Ill.

One of the units, Type RVS (illustrated), is designed for meeting low air volume requirements in ventilating small areas of separate rooms. It operates quietly and can be used with or without ducting. The ventilator is made of aluminum with a centrifugal-type fan wheel and a square base for curb mounting. It is shipped completely assembled, ready for installation. The motor is connected directly to the fan wheel and is sealed from the air stream. An automatic back draft damper is furnished with it as standard equipment.

The other new power roof ventilator, designated Type SB, is of up-blast design. It is made for high speed operation in industrial applications where noise level restrictions are not critical. Its butterfly dampers open automatically when the fan is started. When the fan is turned off, they close by gravity providing a weather tight seal. The hood and damper of the unit are made of galvanized steel. The ventilator is available with capacities up to 37,600 cfm.

**More information? Circle Item 31 on postcard, page 140.**

## 1955 Air-Cooled Systems

An expanded line of air conditioning equipment is announced by Lennox Furnace Co., Marshalltown, Iowa. The equipment includes improved water-cooled systems, and newly developed air-cooled systems, in both remote and self-contained units, the latter being fully hermetic. The air-cooled remote systems will be available in models with 3 and 5-ton capacities; the self-contained units, in 2 and 3-ton sizes.

In the remote models, the High Side unit (illustrated), consisting of the compressor, condenser and condenser blower, drier and automatic controls, is housed in a weather proof cabinet that can be installed out of doors. The Low Side, containing the evaporator and expansion valve and filter, is built into a cabinet that can be set either directly on top, below, or adjacent to a forced air furnace.

The self-contained unit can be installed in the basement, utility room, or carport, with the conditioned air conducted through insulated ducts for distribution to various rooms. It includes a pre-wired automatic control panel and a combination heating and cooling thermostat, with a switch in it for changing from heating to cooling operation.

**More information? Circle Item 32 on postcard, page 140.**

## Circulating Service Pump

A direct-connected, motor-driven, centrifugal pump, known as Type C, has been designed for continuous or intermittent service by Red Jacket Mfg. Co., Davenport, Iowa.

The pump is suitable for use in cooling towers, air conditioning service, swimming pools, lawn sprinklers, booster service, industrial plants, and general recirculating services. Among its construction features is a ceramic-type rotary seal.

Available in ¼, ⅓, ½, ¾, and 1-hp sizes, the pump is made with capacities to 72 gpm at 15-ft suction lift.

**More information? Circle Item 33 on postcard, page 140.**

## Feedwater Heating System

A system that maintains uniform boiler water concentration, and reduces blowdown requirements has been developed by Cochrane Corp., Philadelphia, Pa.

Called the Continuous Blowoff system, the process recovers the heat of the blow-off water. With blow-off water at a temperature corresponding to boiler operating pressure, an induced reduction of pressure causes flashing and steam is generated. This steam can be used to heat feedwater in an open or de-aerating heater. It can also be condensed in a closed heater or flash condenser to heat the feedwater at a point beyond the de-aerating heater.

Complete information on the system is contained in Publication 5700.

**More information? Circle Item 34 on postcard, page 140.**

## Tower Made of Glass Fiber

Cooling towers that are made of glass fiber and called Duro-Lite are designed and manufactured by Baldwin-Ward Mfg. Co., Ottawa, Kan. Weighing about one-third that of steel towers, the units, up to the 10-ton size, can be handled by two men.

Though they have a standard white enamel-like finish, the towers can be impregnated with permanent colors at the time they are molded.

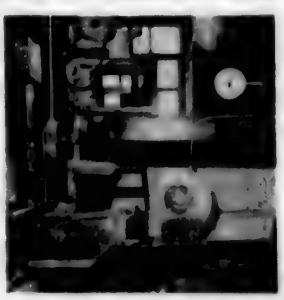
The basic tower consists of three pieces: the upper and lower water basins, and the main housing. All nuts and bolts are made of naval bronze and the fan shaft is made of stainless steel. The fan housing is equipped with a removable, galvanized, steel-mesh safety guard.

Shipped assembled, except for mounting the motor, the towers are available in sizes from 3 to 10 tons.

**More information? Circle Item 35 on postcard, page 140.**

## Stoker Stokes Wood Refuse Fuel

An industrial wood refuse fuel stoker is manufactured by American Coal Burner and Wood Stoker Corp., Chicago, Ill. The stoker, Model ZD-56 is a modified version of the company's Fyr-Feeder air-jet stoker used in industrial plants.



This model can be applied through the front of an existing boiler and arranged to extract and measure fuel from a storage bin, or it can be equipped with a transfer hopper to receive fuel from an existing conveyer or blow pipe system. It is economically priced and burns wet or dry hogged wood, planer shavings, chips, and bark. Fuel is metered to suit steam requirements, mixed with proportioned air in a carburetor-distributor, and then spread on the grate.

Where required, the stoker can be used in conjunction with supplementary fuels, such as coal, gas, or oil and is available for use in industrial plants operating boilers 60 hp and larger.

**More information? Circle Item 36 on postcard, page 140.**

## Unit Has 195-Degree Range

Air conditioning units, called Mil-ac, which are built to meet military specifications, and to operate under climatic conditions from minus 65 to plus 130 deg F, have been developed by Ellis and Watts Products, Inc., Cincinnati, Ohio.

Primarily designed for military trailers, the units can be airborne, or used as stationary units in isolated locations. Their capacities range from 3 to 13½ tons.

The air conditioners are compact, lightweight, and self-contained; their condensers are air cooled, and require no water. Requiring electricity for operation, the units are automatically controlled to ventilate, circulate, cool, heat, filter, humidify, and dehumidify. A control feature allows cooling when outside temperatures are below freezing.

Constructed to withstand 160 deg storage requirements, the units are fungus proof and accessible for service and maintenance.

For specific applications, units of any capacity, arrangement, control requirements, functions, and construction can be designed, developed, tested, and fabricated by the company.

**More information? Circle Item 37 on postcard, page 140.**

## Round Cooling Controls

Residential heating-cooling and cooling-only thermostats featuring a round shape are announced by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

Following the style trend started with its round heating thermostat in 1953, the company's air conditioning controls are designed to harmonize with the interior of the modern home. A snap-on plastic cover can be removed and painted or papered to blend with the interior color scheme of the room in which they are installed.

The thermostats, designated the T-87A and T-87C, provide control of cooling and, in one model, the T-87A (illustrated), manual selection of heating or cooling. Switches, mounted on a sub-base, give a choice between automatic cooling and system shut-off; heating, cooling, or system shut-off; and cooling, system shut-off, and constant or intermittent fan operation. The sub-bases are mounted on the wall separately from the thermostat and wiring connections are made to it before the thermostat is mounted.

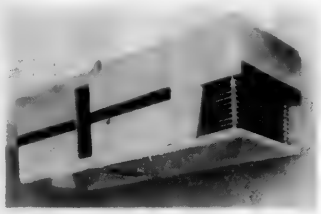
Both thermostats are designed for use with the company's heating-cooling control panel, W-212. They feature adjustable heaters for cooling anticipation to prevent an excessive temperature increase before the compressor turns on. Conversely, uncomfortable temperature overshoot at the end of the compressor cycle is eliminated.

Identical in appearance with the round heating thermostat, the cooling-only control, T-87C, can be mounted alongside the heating control in installations having separate heating and cooling systems.

**More information? Circle Item 38 on postcard, page 140.**

## Horizontal Air Conditioners

Packaged air conditioners that require no floor space are introduced by General Electric Co., Bloomfield, N. J., for use in stores, offices, and factories.



Designed to be suspended from the ceiling or shelf-mounted, the horizontal units are made in both water-cooled and air-cooled models, and are available in 3, 5, and 7½ ton capacities. The waterless models (illustrated) are completely packaged air-cooled air conditioners.

The same hermetically-sealed condensing unit that is used in the company's floor models is used in the water-cooled units. Motor, compressor, and condenser are permanently sealed in steel and lubricated. The refrigeration system is replaceable and is covered by a 5-year warranty.

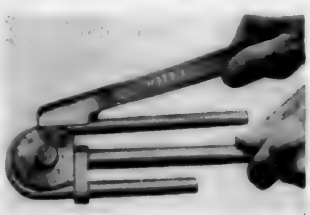
On air-cooled models return air enters through grilles at the bottom and sides of the unit; on water-cooled models air enters at the rear. The side panels snap off for servicing.

Accessories to the units include a heating coil, which can be used with steam or hot water, and a 3-way directional air distributor for free air delivery within the conditioned space.

**More information? Circle Item 39 on postcard, page 140.**

## Bends Hard or Soft Tubing

Lever-type tube benders which can bend both hard or soft tubing are announced by The Imperial Brass Mfg. Co., Chicago, Ill. The benders, whose trade name is Blue Dot, can be used for bending hard-drawn copper, stainless steel, and JIC steel tubing, and do not require a clamp to keep the tube from slipping.



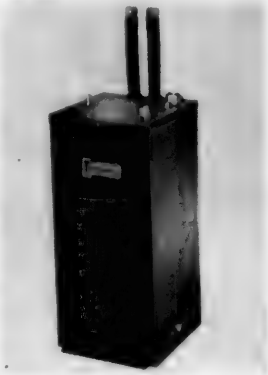
Bends can be made to any angle up to 180 deg without adjusting the tubing or bender. The bending form is calibrated to show degree positions.

Each bender handles one size of tubing. The company makes benders for sizes from 3/16 to ¾ in. OD tubing; benders for ⅝ and ¾ in. OD tubing have longer pipe handles. Bulletin No. 3038 lists the sizes, weights, and prices of the benders.

**More information? Circle Item 40 on postcard, page 140.**

## Tank Cools Drinking Water

A water cooling tank, available with or without an insulated cabinet, is manufactured by Temprite Products Corp., Birmingham, Mich.



The tank is designed for custom water cooling installations to make it possible to choose a condensing unit to fit individual requirements. It is adaptable to locations with restricted space, for the condensing unit can be located remotely. Water outlets, either bubbler, glass filler, or standard tap, can also be selected to meet customer needs. Existing water outlets can also be utilized, and either existing or new condensing units employed.

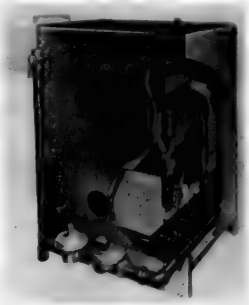
The cooling tank can be used as an auxiliary cooling unit, added to an existing cooling system for increased capacity. It can also be used to replace deteriorated cooling units in soda fountains and bars, or to replace defective cooling tanks in old self-contained coolers. Extra outlets can be piped from a single tank, to meet the glass-filling requirements, for example, of a busy restaurant counter.

Cabinet model XW-150C measures 7⅛ sq. in. x 15⅛ in. high. Its cooling capacity is rated at 27 gph, when used with a precooler, under standard rating conditions of 90 deg F room temperature and 80 deg water inlet.

**More information? Circle Item 41 on postcard, page 140.**

## Two Different Size Boilers

Two gas-fired boilers, the G-6 and G-4, are introduced by Plumbing and Heating Div., American Radiator & Standard Sanitary Corp., Pittsburgh, Pa. The boilers are constructed so that their 20-gage steel jackets can be assembled after water, gas, and steam piping has been installed.



The G-6 (illustrated), with its input capacity range of 650,000 to 5,200,000 Btu per hr, can be roughly classified as an industrial or commercial boiler suited to schools and apartment and office buildings. The G-4, with an input range of 180,000 to 600,000 Btu per hr, can be used in homes, churches, and small industrial and commercial buildings.

Both boilers have integral drafthoods located at the rear of the jacket enclosure. The overall height of the G-6 is 65 in. and of the G-4 47½ in. Cleanout cover plates provide access to flue surfaces, and removable access panels on the jacket front make the boiler sections accessible without the necessity of removing the entire boiler jacket.

Installation of the G-6 boiler is facilitated by assembling the sections directly on a separate cast iron base. The burners and mixing tubes are placed inside the base and are supported by a rigid spacing bar. Installation time is thereby reduced since the sections, burners, and mixing tubes are automatically spaced and aligned. The valves and control piping for both boilers are factory assembled.

The G-4 boiler is constructed with extended end sections which form the legs of the boiler. The center boiler sections are suspended between the ends and secured with tie-rods, thus eliminating the need for separate end or center supporting legs.

Both boilers are constructed of cast iron; both comply with ASME specifications and are approved by the American Gas Association.

**More information? Circle Item 42 on postcard, page 140.**

## Utility Unit Heaters

A line of gas-fired utility unit heaters with horizontal discharges is produced by L. J. Wing Mfg. Co., Linden, N. J. Included in the line are two designs of unit heaters and a new duct-type heater.

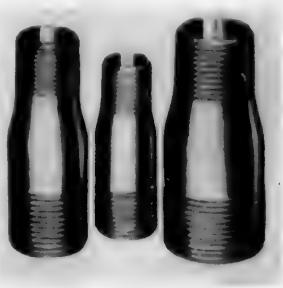
The exterior casings of the heaters have rounded contours and a gray, baked-enamel finish. Inside the heaters, the combustion chamber and heat exchanger are built of 16-gage aluminized steel, which is welded into a one-piece assembly. A built-in draft diverter, four-bladed aluminum propeller-type fans, cast iron burners with drilled ports, and automatic safety controls are other features of the heaters. They range in size from 50,000 to 230,000 Btu per hr input.

The company also produces a line of gas-fired unit heaters for ceiling suspension and downward discharge through fixed or revolving discharge outlets.

**More information? Circle Item 43 on postcard, page 140.**

## Reducing Nipples

Gas and water service lines can be assembled with the reducing nipples produced by Twin City Steel Mfg. Co., Minneapolis, Minn.



Used in place of conventional reducers and bushings, the fittings eliminate extra joints in order to reduce the sources of possible leaks. The fact that they are made of one-piece provides a smooth inner wall that reduces friction loss.

The nipples are available in welded standard black or galvanized and seamless pressure tube, standard and extra heavy black in sizes from ¾ to 1¼ inches in diameter.

**More information? Circle Item 44 on postcard, page 140.**

## Auxiliary Water Heater

A direct, oil-fired water heater that is self-contained and does not require an added fuel tank is manufactured by Radiant Utilities Corp., Brooklyn, N. Y. Designed for low-cost auxiliary installations in restaurants, hotels, motels, laundries, schools, hospitals, and other institutions, the water heater is constructed according to ASME standards.

The heaters are furnished with a combustion chamber and relief valve for continuous operation under all conditions. An insulated flush steel jacket is provided for additional protection. They have been tested to 150 lb pressure.

The oil-fired water heater operates as an independent unit, burning fuel from the same tank which supplies oil to the heating unit. However, facilities are provided for adding a storage tank for increased capacity, if needed. The units are supplied with automatic safety and water temperature controls.

The heaters are guaranteed for five years.

**More information? Circle Item 45 on postcard, page 140.**

## Damper Is Added to Diffuser

A built-in, adjustable damper is added to the perimeter diffusers manufactured by Titus, Inc., Waterloo, Iowa.

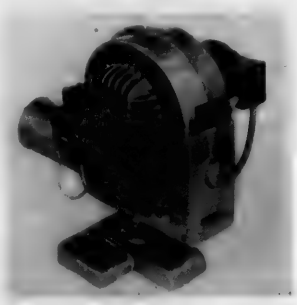
Operated by a lever control from the center of the top slot, the damper can be adjusted from full-open to full-closed positions. It has an adjustable screw stop that will adapt the damper's opening to special air volume requirements.

The operating mechanism of the damper is a direct connection that does not use chains.

**More information? Circle Item 46 on postcard, page 140.**

## Home and Store Oil Burners

Three oil burners covering a range of applications from medium-sized homes to commercial installations are announced by The Nu-Way Corp., Rock Island, Ill.



The Model CO-800 (illustrated) has a firing range from 3 to 8 gph, twin nozzles, and a two-stage pump. For added safety, the burner is equipped with a delayed action valve. Built extra heavy, the unit has a sand-cast aluminum alloy housing and a heavy transformer. It is available with adjustable floor or flange mountings.

Models XL-1500, 8 to 15 gph, and XL-2000, 15 to 20 gph, are also built with sand-cast aluminum alloy housings. In addition, they are equipped with twin nozzles, a dual ignition system, and two independent transformers. An electronic primary-mounted relay is standard equipment on these models. Forward and backward adjustment of the nozzle can be made while the burner is in operation to give flexibility for unusual firing conditions. Both models have adjustable floor mountings.

**More information? Circle Item 47 on postcard, page 140.**

## Cooling Tower Uses No Bolts

A cooling tower that can be erected by two men, using no bolts, is a product of Dover Mfg. Co., Independence, Mo. The tower consists of a one-piece welded steel basin and a one-piece welded steel crown assembly held together by an adjustable tie rod, and redwood, or steel, louvers that fit into slotted vertical posts.

The two men in the photograph assembled the tower in 20 minutes. The man on the right is placing the remaining louvers into the posts, while the other man is affixing one of four galvanized intermediate steel braces to the corner posts with galvanized wood screws.

The company is making the towers in sizes from 3 to 15 tons.

**More information? Circle Item 48 on postcard, page 140.**

## Coating Protects Wood Forms

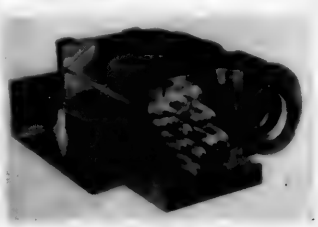
A plastic coating, Alum-a-coat No. 757, for prolonging the life of the wooden boards used in forms during concrete construction operations, has been developed by Protectub, Inc., New York, N. Y.

Coating the form with this material, to prevent the concrete from sticking to the wood, extends the life of the forms to about 12 times and permits a reasonable resale value on the wood after discarding. It comes packed in 1- and 5-gal. cans as well as 55-gal. drums.

**More information? Circle Item 49 on postcard, page 140.**

## Transom-Size Remote Cooler

A remote air conditioning unit, known as the Ceiling Hideaway, is being marketed by International Mfg. Co., Oklahoma City, Okla. Its cabinet, which is 11 in. high, is small enough to be installed above the door to a closet or bath room and requires no additional duct work.

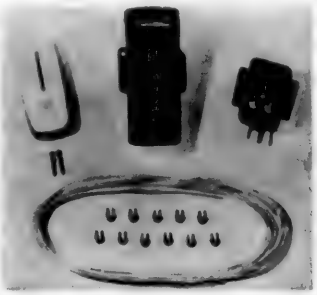


Made of aluminum to prevent corrosion and deterioration, the unit is individually controlled by a wall switch and operates from a central chilled water system. The maintenance of the air conditioner is kept to a minimum by its design, which permits the motor and blower assembly to be lifted out and another installed in a relatively short time.

**More information? Circle Item 50 on postcard, page 140.**

## Gas Heater Control

An electric thermostat-type control, the 55ET, for gas heating appliances is designed for use with the Model 55 Gasapack, manufactured by A-P Controls Corp., Milwaukee, Wis. The illustration shows the kit that is furnished with the electric operator. It includes wire, a plug-in transformer, a wall thermostat, and wiring diagrams. To install the control, it is not necessary to break the line.



A wall-mounted thermostat with low voltage operation regulates the automatic operation of the control. It can be set to operate from high fire to off, or from high fire to low by-pass flame, depending on the need.

The control is the third of three automatic accessories announced by the company.

**More information? Circle Item 51 on postcard, page 140.**

## Timer for Industrial Operations

An automatic reset timer for timing and sequencing electrical load circuits on industrial machinery and process operations is manufactured by Automatic Temperature Control Co., Inc., Philadelphia, Pa. Known as Atcotrol, the unit can be used for exhaust fans, water treatment, pump control, and temperature programming in addition to its other applications.

Rated at 10 amp at 115 v a-c, the timer mounts into a single round cut-out 3-3/16 in. in diameter and is secured in place by tension studs on a back-up ring held in position by an O-ring retainer. It can be installed into panels up to ½ in. thick.

The timer has 10 timing ranges from 0-to-15 sec, with a minimum setting of ¼ sec, to 0-to-240 min, with a minimum setting of 240 sec.

**More information? Circle Item 52 on postcard, page 140.**

## Replaceable Capillary Pack

A contact and eliminator pack for air conditioning units is announced by Air and Refrigeration Corp., New York, N. Y. It is designed for heating, cooling, humidifying, dehumidifying, and air cleansing units that require a replaceable capillary pack.

The fill pack contains approximately 57,000 individual Fiberglas strands covering an area of 125 sq ft in a cell 20 x 20 in. in face dimensions and 8 in. in depth. Although the glass fibers within the cell appear to fill it, they actually occupy about one and one-half per cent of the cell volume. This fact combined with the parallel arrangement of the glass fibers accounts for the low resistance to the air flow through it. The dust spore removal performance of the capillary cell pack is in excess of 95% by weight of the air-borne solid matter including all particles exceeding 5 microns in size and most of those down to 1 micron.

Replacement of the Fiberglas pack within the cell is necessary when the collected dust reduces the efficiency of the pack. The company has a standard set of instructions for changing the Fiberglas pack.

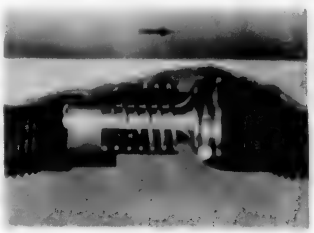
The contact and eliminator pack comes ready for installation. After the paper wrapping and reinforcing cardboard have been removed, the pack should be placed in the capillary cell while still tied. When untied, the glass strands will expand, filling the cell.

Once the cell has been filled, it should be turned to a 90 deg angle in order that the glass fibers can be oriented into a parallel pattern. When the strands are parallel a check should be made sighting through the cell toward a strong light to determine the density uniformity in the cell. By holding the cell to the light, the fibers can be moved to fill holes that may have developed while packing.

**More information? Circle Item 53 on postcard, page 140.**

## High Pressure Check Valve

A check valve for use in the range from 0 to 10,000 psi is manufactured by James-Pond-Clark, Pasadena, Calif., and is called the 2300 Series by the company.



Suitable for most high pressure or pneumatic applications, the valve has a one-piece body and an O-ring, which serves as a sealing member and absorbs closing shocks. Both the valve body and O-ring are available in several combinations of materials for a variety of liquid or gas services.

The valve has a spherical metal seat that supports the O-ring while seating it.

**More information? Circle Item 54 on postcard, page 140.**

## Power and Flow Controller

An automatic input controller, called the Inputrol, is a product of Wheelco Instruments Div., Barber-Colman Co., Rockford, Ill. The device controls the input rate of electrical power as well as the flow of liquid or gas to processes in accordance with changes in the measured variable.

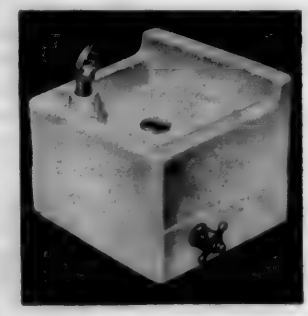
The design of the control permits the use of either fast or slow rates. Input rates can be adjusted to the lowest value consistent with safety to equipment and loads, or, if required, the control will provide 100% of the maximum design input until a predetermined point has been reached.

Bulletin F 5726-1 describes and illustrates the control in detail.

**More information? Circle Item 55 on postcard, page 140.**

## Wall Fountain for Schools

A wall fountain, the Model No. 7X, that is adaptable for either school or general purpose installations is the latest design drinking fountain of Haws Drinking Faucet Co., Berkeley, Calif.



Constructed of acid-resistant, enameled cast iron, the fountain is expected by the manufacturer to meet the requirements of city and state material specification codes. Its operational features include an angle stream and a shielded head made of chromium-plated brass for sanitary purposes. The bubbler is mounted above the bowl rim so that back-up water from plugged drains cannot touch the supply outlet.

The fountain also has an automatic stream control of pressure and volume to prevent water from splashing onto floors or walls.

**More information? Circle Item 56 on postcard, page 140.**

## Damper Hardware Kit

A feature known as Neva-Bind is being included in Duro-Blade damper hardware kits manufactured by Duro-Dyne Corp., New Hyde Park, N. Y. The addition of the feature to the kit enables the component parts of the damper hardware to prevent damper binding caused by inaccuracies in assembly.

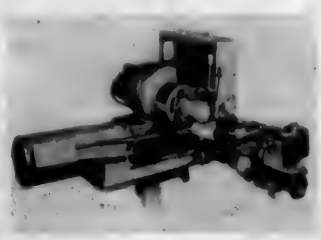
Previously, a slight misplacement of a bracket, a slight inaccuracy in a blade dimension, or a misplacement of a bearing hole in the frame caused the blade connecting rod to bend. The bending of the rod requires extra energy and increases friction in the bearing surfaces, thereby making movement difficult. The kit compensates for such inaccuracies that occur during damper construction or assembly.

**More information? Circle Item 57 on postcard, page 140.**

## Industrial Gas-Oil Burner

An industrial combination gas-oil burner, type DFG, is being produced by Roberts-Gordon Appliance Corp., Buffalo, N. Y., manufacturers of industrial and residential heating equipment.

The dual-fuel burner operates on city gas and No. 2 oil, and is available in three sizes with input capacities from 360,000 to 4,300,000 Btu per hr. Assembled, wired, and fire-tested, the combination burner can be put in operation in installations where pressure or temperature changes require automatic fuel switch-over. Manual switch-over is possible and can be arranged to over-ride the automatic switch-over control.



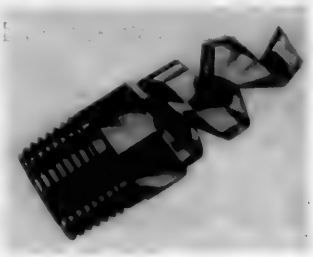
Built with plug-in electronic controls, it is furnished with a diaphragm gas valve, a gas pressure regulator, a double-acting barometric draft regulator, a main shut-off valve, a pilot flame electrode, and a photo cell for oil.

Optional control components of the burner include a governor-type modulating diaphragm valve or an accessory motor-operated modulating valve, both available with a low-fire start. An electronic control system employing a flame flicker cell to monitor the pilot, main gas flame, and oil flame is available. Special safety, operating, limit, switch-over, draft, and combustion controls can also be furnished.

**More information? Circle Item 58 on postcard, page 140.**

## Nozzles for Fire Fighting

A series of fog nozzles for fixed fire protection and other industrial applications is announced by Bete Fog Nozzle, Inc., Greenfield, Mass.



Called the Tu-Cone N series, the nozzles employ two spiral turns, producing an inner and outer cone which results in uniform coverage over a 90-deg cone. They are made from one small piece of ⅞-in. hex metal and have no internal parts so that particles in the spray smaller than the orifice will pass freely through the nozzle without clogging.

Made with ½-in. male pipe thread in brass or stainless steel (Type 416 or 303), the nozzles are available in five models with flow rates from 5 to 50 gpm, all with a 90 deg solid cone pattern. Their overall length is 2½ in.

**More information? Circle Item 59 on postcard, page 140.**

## Sheet Metal Ball Joints

Pre-fabricated sheet metal flexible ball joints are announced by Spincraft Inc., Milwaukee, Wis. The units are available in eight pipe sizes, ranging from 3 to 12 inches in diameter.

The flexible ball joints can be used in installations such as exhaust systems, for dust and noxious fumes, and in blower systems, for air conditioning and ventilating. Pre-assembled, they are made from three pieces and do not require heavy supports.

The manufacturer points out that the 7 and 9-in sizes provide a total arc of 45 deg; all other sizes permit a 55-deg total deflection.

Information and prices for standard units or special sizes and heavier gages or special materials can be obtained on request from the manufacturer.

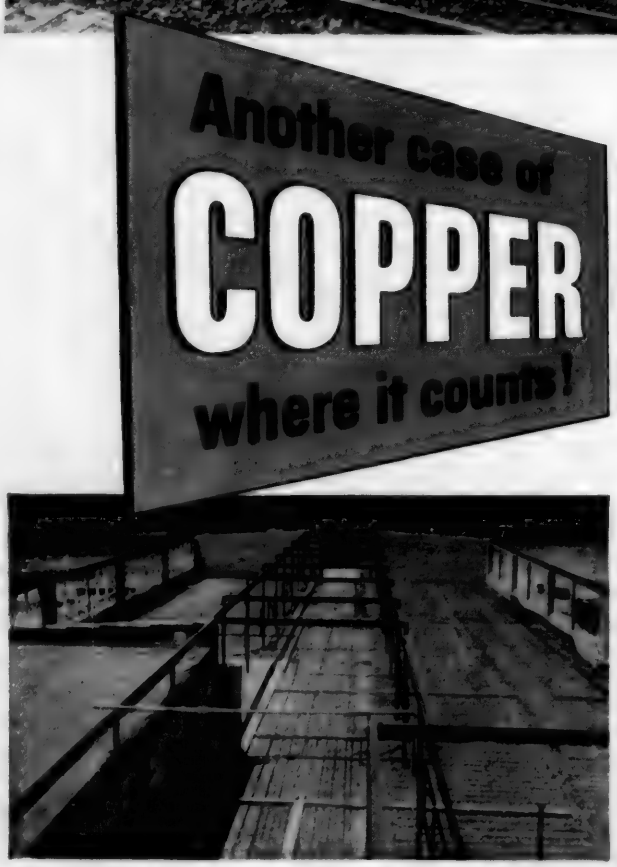
**More information? Circle Item 60 on postcard, page 140.**

(*Concluded on page* 138)

## MANCHESTER ELEMENTARY SCHOOL

**Manchester, Missouri**

*Architect:* CHARLES W. LORENZ, Kirkwood, Mo.
*Contractor:* JUENGEL CONST. CO., St. Louis, Mo.
*Radiant Heating:* BAGLEY & COMPANY, Inc., Robertson, Mo.
*Revere Distributor:* GRINNELL COMPANY, Inc., St. Louis, Mo.




**TWO VIEWS** of the radiant Panel heating layout before concrete slab was poured. Floor area over 17,000 sq. ft. System was imbedded in slab 4". Gravel fill is 6" deep. Coils are 12" OC. System is divided into 4 zones, with all supply and return lines also of copper. Note edge insulation at right in large photo.

Radiant Panel Heating fits perfectly into the growing trend to 1-story school construction. It means warm floors, no drafts, and a healthier atmosphere for scholars. To the architect radiant panel heating means greater latitude in design, more usable space for the money. And for the user it means greater heating efficiency, lower redecorating costs and less cleaning and maintenance than when old-fashioned heating methods are used. The ideal material for panel heating is copper. For no other metal or alloy has all the desirable construction characteristics of this "ageless" metal.

To the contractor, the use of Revere Copper Water Tube means easy bending and handling . . . its long 60' lengths require fewer fittings, the solder fittings used eliminate the need for welding, wrench work and thread cutting, while its lasting, non-rusting qualities have been proven through the centuries. Even being buried in a concrete slab doesn't bother enduring copper. Copper is the metal you can trust.

Keep out of trouble, protect your reputation for quality work . . . use Revere Copper Water Tube for air conditioning lines, radiant panel heating, hot and cold water lines, underground service lines, waste stack and vent lines, processing lines. See the Revere Distributor nearest you today. And, if you have a technical problem, he will put you in touch with Revere's Technical Advisory Service.

**REVERE**

**COPPER AND BRASS INCORPORATED**

*Founded by Paul Revere in 1801*

230 Park Avenue, New York 17, New York

*Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.*

(*Concluded from page* 136)

## Motor-Driven Tube Cleaner

An electrically-driven cleaner for air conditioning condenser tubes, ⅝ to ⅞-in. OD, is announced by Thomas C. Wilson, Inc., Long Island City, N. Y. Called the AB Tube Cleaner, it is designed for simplicity of operation in the rapid removal of algae, slime and mud deposits. Its use results in the reduction of condenser head pressure.

Equipped with a carrying handle and a built-in base, the cleaner is lightweight and portable. It is powered by a ¼-hp, 3450-rpm motor, available in 110-220 v a-c, and single phase only. The motor drives an expanding brush (arrow) attached to a flexible shaft.

Several types and lengths of flexible shafts and metallic casings are available for various tube sizes. The assembly is attached to the motor by means of a grooved spline connection.

**More information? Circle Item 61 on postcard, page 140.**

## Trailer Carries Pipe Shop

A line of mobile pipe shops is announced by Gaines-Collins, Los Angeles, Calif., manufacturers of automatic pipe threading and cutting machines. The first of the line to be introduced is a trailer, designed for the company's Thred-O-Matic 44, to permit on the job cutting and threading of pipe.

The trailer can be hitched onto a car or truck and has enough room to accommodate a generator to operate the pipe machine. By undoing four bolts, the wheels of the trailer can be moved forward on an eccentric axle, and the trailer platform can be lowered to the ground to permit operation of the machine. This eliminates the need for removing the machine from the trailer in doing field work or when the machine is moved around a plant to where it is needed.

The total weight of machine and trailer is 1800 lbs.

**More information? Circle Item 62 on postcard, page 140.**

## Cooling Tower Fan Propellers

Fan propellers, with 18-8 stainless steel blades and rivets, for cooling towers are being made by Alloy Propeller, Zelienople, Pa., in addition to its standard steel propellers.

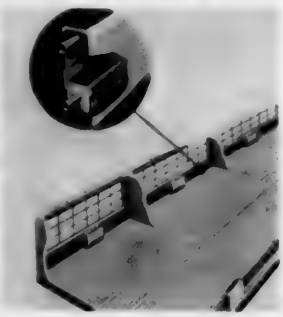
Both the stainless and standard steel propellers are designated Type QC, and are available in sizes from 12 to 48 inches in diameter. All of the various size propellers are made with a choice of at least three bore diameters, ranging from the smallest, 5/16 in, on the 12-in size to the largest, 1⅜ in, on the 48-in size. On the 36, 42, and 48-in diameter propellers, seven different bore diameters are available, each with a standard keyway.

A variety of finishes are offered for the propellers; however, a red enamel finish is standard, and a red chromate prime coat can be had at no extra cost.

**More information? Circle Item 63 on postcard, page 140.**

## Heating System for Schools

A hot water heating system, the Wind-O-Line, for schools is introduced by John J. Nesbitt, Inc., Philadelphia, Pa. The feature of the system is the savings it makes possible through the elimination of pipe trenches, and through the use of smaller piping and pumps, and factory-assembly of the piping within the unit ventilator. In addition to the savings, the company claims that its system will produce greater classroom comfort.



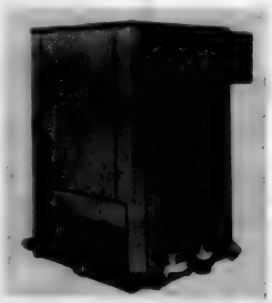
The system uses two components: the Syncretizer unit ventilator and the Wind-O-Line gravity radiation. The latter can be either wall-hung or concealed behind the company's storage cabinets; its tubing serves as the supply and return piping for the unit ventilator and provides moderate gravity radiation along the sill to protect against cold window down-drafts.

Direct control of the water temperature by outdoor temperatures increases the system's heating capacity according to the heat load.

**More information? Circle Item 64 on postcard, page 140.**

## Boiler for Large Installations

A gas-fired boiler designed for steam or hot water heating and large volume indirect water heating is introduced by Bastian-Morley Co., Inc., La Porte, Ind. Called the Series 600, the boiler is an addition to the company's Arrow-Line of boilers.



Suitable for service in factories, hotels, schools, and office buildings, the boiler is approved by the AGA for all gases, including LP-gas and LP-air. It is available in 36 sizes, 6 to 41 sections, with input capacities ranging from 625,000 to 5,000,000 Btu per hr.

A feature of the boiler's design are the internal steam separators cast into each cast iron section. The boiler is encased in Fiberglas insulation, and electronic controls for it are optional at extra cost. Specifications and roughing-in dimensions are available from the manufacturer.

**More information? Circle Item 65 on postcard, page 140.**

# PRODUCT INFORMATION SERVICE

**Use the postage-free postcard below for further information on:**

- **News of Equipment and Materials**

**or a copy of the following**

- **New Catalogs**

**Circle the item Numbers in which you are interested and print clearly your name and address with title.**

## NEW CATALOGS

**WATER HEATER SLIDE RULE**—A tool for determining the size of a Burkay commercial water heater installation is provided by a slide rule, issued by Permaglas Div., A. O. Smith Corp., Kankakee, Ill. The slide rule has two operating faces, one for apartment sizing and another for restaurants. By feeding in primary data on the number of apartments and the numbers of rooms in each apartment, the user finds the slide rule coming back with the size and number of water heaters that will feasibly carry the job, also the size of the storage tank in gallons needed to hold hot water for the building. By determining the approximate number of hours of dishwashing periods and the maximum number of people served at the main meal, the opposite face of the slide rule gives the water heater and tank size needed for restaurant operations. Other data of a helpful nature is also printed in detail on the slide rule.....Item 101

**FAN AND HEATER CATALOG**—Its 1955 catalog of exhaust fans and fan-type electric heaters has been prepared for national distribution by Broan Mfg. Co., Inc., Milwaukee, Wis. Presenting new ideas and recent improvements in the company's kitchen fans and bathroom heaters, the catalog serves as a guide for purchasers and installers. The company's entire line of residential exhaust fans and electric bathroom heaters are represented in the catalog by photographs, dimensional drawings, specifications, installation suggestions, and suggestions for efficient kitchen ventilation. The catalog also describes adapters and extensions for use with various fans.....Item 102

**DATA ON TWO-STAGE PUMPS**—A 12-page pamphlet, Bulletin 107, describing 13 models of 2-stage regenerative turbine pumps is offered by Roy E. Roth Co., Rock Island, Ill. It contains illustrated photographs, numerous cross section diagrams illustrating the principle of operation, data on mechanical seals available, installation dimensions and performance tables covering the performance of the pumps handling both cold and hot water. The pamphlet is so arranged that the first four pages cover general description, the second four cover specification and dimensions on 2000 series pumps and the third four cover specification and dimensions on 3000 series pumps.....Item 103

**MIXING VALVE BUYING GUIDE**—Basic types of thermostatic water mixing valves are the subject of a condensed buying guide, CBG55, published by Leonard Valve Co., Cranston, R. I. The illustrated folder shows and describes various types of thermostatic mixers according to use and gives mechanical detail including sizes, capacities, and other specifications.....Item 104

**CONTROL VALVES ARE CATALOGED**—An 8-page catalog, Bulletin C-6, covering its selection of thermostatic control valves, is issued by Lawler Automatic Controls Inc., Mt. Vernon, N. Y. The catalog consists of sections covering temperature regulators, tempering valves, shower valves, water controllers, water pressure equalizers, photographic controls, and hospital equipment.....Item 105

**INDUSTRIAL VALVE CATALOG**—A condensed Milvaco catalog, No. BB35, of bronze valves for the plumbing and heating industry is issued by Milwaukee Valve Co., Milwaukee, Wis. The 8-page 2-color catalog covers 15 different types of valves in a variety of sizes. Listed with their descriptions, sizes, and weights, are gate valves, angle valves, globe valves, check valves, manifold header units, foot valves, strainers, needle point valves, and relief valves. The bulletin's design lets the user see at a glance the right type valve for any installation.....Item 106

**PAMPHLET OUTLINES IBR RATINGS**—An illustrated pamphlet, entitled What Standard Do You Demand, and outlining the significance, advantages and basis of IBR ratings of boilers, baseboards, and commercial finned-tube radiation, is published by Institute of Boiler and Radiator Manufacturers, New York, N. Y. Written for architects, engineers, builders, and others who specify or install heating equipment, the pamphlet discusses the value of the ratings as impartial, permanent standards.....Item 107

**PLASTIC PIPE USES ARE LISTED**—The publication of an eight-page bulletin on rigid plastic fabrications and pipe is announced by The Atlas Mineral Products Co., Mertztown, Pa. The bulletin outlines the use of Type I polyvinyl chloride in the fabrication of exhaust systems, process equipment, and processing tanks. The resistance characteristics and physical properties of the plastic are included in the section. Also included in the bulletin is a section on plastic pipe and fittings. Description and tables on chemical and physical properties of Type I and II polyvinyl chloride and styrene copolymer rubber resin blend rigid plastic pipe is included.....Item 108

**AIR CLEANING BOOKLET**—An 8-page booklet, The Philadelphia Story, is published by Trion, Inc., McKees Rocks, Pa., on the application of its electronic air cleaning equipment in the city of Philadelphia. The booklet tells of the advantages provided by the equipment in many diversified applications in some of the city's most prominent buildings. It is classified by the company as Comparison Study CS-10.....Item 109

**COMPRESSED AIR HANDBOOK**—The first 8 pages of bulletin No. 120, published by Sarco Co., Inc., New York, N. Y., comprise a handbook with hook-up sketches to help users of compressed air to improve the capacity of their installations. The compressed air handbook features cooling controls for compressor jackets, aftercoolers, and intercoolers. It also describes drain traps, electric thermostats, and pressure switches.....Item 110

Postage Will be paid by Addressee

No Postage Stamp Necessary If Mailed in the U. S.

**BUSINESS REPLY CARD**

FIRST CLASS PERMIT NO. 36, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

**AIR CONDITIONING, HEATING AND VENTILATING**

**93 WORTH STREET**

**NEW YORK 13, N. Y.**

READERS' SERVICE DEPT.

**[illegible] FURNACE BULLETINS**—Four bulletins, each giving the specifications, dimensions, and operating data of one of its heaters or furnaces, are issued by Rennie Mfg. Co., Mercer, Pa. Bulletin B-55-P describes a packaged heater that can be used either as a horizontal furnace or as a deluxe unit heater. Bulletin B-55-US covers suspended gas unit heaters. Bulletin B-55-DS contains information on a series of sectional duct furnaces, and Bulletin B-55-D provides similar information on small capacity duct furnaces for residential or commercial installations.....Item 111

**TIPS ON AIR CONDITIONING**—Helpful tips on ways to apply economical and efficient air conditioning to more than a score of different types of buildings, ranging from homes to manufacturing plants and retail establishments, are outlined in booklet A-47E available from E. I. Du Pont de Nemours & Co., Wilmington, Del. Entitled Guideposts to Better Air Conditioning Installations, the 56-page booklet is a compilation of semi-technical articles by outstanding engineering consultants. Separate sections are devoted to comfort cooling of living quarters, including hotels and apartment houses; public and commercial buildings, hospitals and restaurants; manufacturing and warehousing plants; and retail shopping centers as well as individual stores. Another section, of particular interest to architects, contains suggestions on the most practical location of air conditioning equipment from a building design standpoint.....Item 112

**CATALOG OF CONTROL DEVICES**—A 48-page catalog of general purpose control devices, including a special section containing components, by horsepower, for each type of motor control application, is announced by General Electric Co., General Purpose Control Dept., Schenectady, N. Y. Designated GEC-1288A, the 2-color publication contains photos, book prices, wiring diagrams and dimensions on motor starters, contactors, relays, solenoids, switches, push buttons and pilot devices. Also included is information comparing applications and merits of manual and magnetic control, and across-the-line and reduced-voltage control. The special section on control selection shows by enclosure, type, and rating the exact components of motor control systems for each horsepower rating, including starters, push buttons, heaters, together with their order numbers and book prices. Other data cover starter modifications, auxiliary interlocks and renewal parts.....Item 113

**BULLETIN ON WEATHER CONTROLS**—A 4-page, illustrated bulletin, No. 191, explaining the cash benefits of indoor-outdoor building heat controls, is offered by Automatic Devices Co., Inc., Western Springs, Ill. Aimed at contractors and building owners, it describes in detail the operation of 3 different control units for buildings of various sizes and heating systems.....Item 114

**AIR TRANSMISSION MANUAL**—A 48-page manual on high pressure air transmission is published by Connor Engineering Corp., Danbury, Conn. While cataloguing the company's line of high pressure diffusers, valves, and reducing outlet chambers, the manual is virtually a textbook which undertakes to make available current data on air distribution techniques. Information of value to air conditioning, heating, and ventilating engineers is provided by the manual. Where high pressure air transmission may be used to advantage, engineering considerations, single and dual duct designs, typical layouts, velocity and pressure factors, duct sizing and construction, and sound control are among the subjects covered, with numerous illustrations, charts and selection tables.....Item 115

**BULLETIN ON PIPING MATERIALS**—Bulletin 19154, published by Porter-Hayden Companies, Newark, N. J., in color, covers the essentials pertaining to underground piping conduit. It shows how Therm-O-Tile conduit is constructed and installed, how the piping is supported, anchored and guided, and the arch diameters and base sizes to use for various pipe combinations. It also shows the U-type conduit for one-pipe installations or jobs having several small pipes.....Item 116

**REFRIGERATION SYSTEMS CATALOG**—A 12-page, 2-color catalog covering its line of low temperature refrigeration equipment is issued by Bush Mfg. Co., West Hartford, Conn. Included in the catalog are illustrations, system diagrams, and specifications on hot gas defrost systems, electric defrost systems, and glycol defrost product coolers as well as water defrost unit coolers.....Item 117

**ANTHRACITE EQUIPMENT STUDY**—An engineering appraisal of the factors involved in fuel and equipment selection for buildings in the eastern seaboard of the United States is available in reprint form to engineers, heating contractors, and building operators from Anthracite Information Bureau, New York, N. Y. Entitled Anthracite for Space Heating, the four-page, illustrated study formed part of a presentation on newly developed automatic anthracite burning commercial equipment delivered recently to United States government engineers who select fuel for federal buildings. The reprint includes a study of the new hard coal burning equipment which is available in the commercial heating field. Illustrations include a map showing the freight rate structure within a 150-mile radius of the anthracite producing centers; an engineering diagram showing building heating efficiency and a table of automatic anthracite equipment and their steam capacities.....Item 118

**[illegible] FAN BULLETIN**—Sidewall fans and their applications are the subject of an 8-page, illustrated bulletin available from Kedy Blower Co., Trenton, N. J. The bulletin gives the performance data of nine different size fans in cfm at various stages of resistance in inches of water. Two tables list the dimensions of two different type roof fans that use the basic blower unit.....Item 119

**BROCHURE ON PIPE FILTERS**—Its line of Type PL pipe line filters, designed for removal of water, oil, dirt and pipe scale from compressed air or gas lines, is detailed in a brochure available from Airmaze Corp., Cleveland, Ohio. The literature is illustrated, and contains engineering, operating, and application information. Also included in it is a table for computing the correct size filter for a given installation. One page is devoted to specifications of all the company's standard models.....Item 120

**PICTORIAL PRODUCT REVIEW**—A pictorial review of its entire line of heating, air conditioning, ventilating, and heat exchange equipment is published by The Trane Co., La Crosse, Wis. In the 36-page publication, the company attempts to present its complete line rather than complete information on a single product. The table of contents of the review lists the number of the company's bulletins that give complete information on individual products.....Item 121

**ABSORPTION COOLING CATALOG**—Absorption refrigerating machines, which produce large-capacity cooling from steam and use plain water as a refrigerant, are described in a 36-page catalog prepared by Carrier Corp., Syracuse, N. Y. The machines are produced in cooling capacities of 100 tons and up for air conditioning and for process refrigeration applications. The catalog has been designed for use by laymen as well as technicians and consulting engineers. For example, the operation of the complex refrigeration cycle is explained in four steps. Important features of the absorption machine are illustrated by testimonials from prominent business and industrial users. Capacity ratings are listed in easy-to-read tables and physical characteristics for the 12 different models are shown in a double-page chart. Also included is a comprehensive list of installations for comfort and industrial processing with representative photographs. Engineering data include illustrated nozzle arrangements for both internal coil and open type machines, pipe connection data, sections on electric wiring, and how the control system functions.....Item 122

PLEASE SEND ME MORE INFORMATION. Circle below item numbers on which you wish further information.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11 | 21 | 31 | 41 | 51 | 61 | 101 | 111 | 121 | 131 | |
| 2 | 12 | 22 | 32 | 42 | 52 | 62 | 102 | 112 | 122 | 132 | |
| 3 | 13 | 23 | 33 | 43 | 53 | 63 | 103 | 113 | 123 | 133 | |
| 4 | 14 | 24 | 34 | 44 | 54 | 64 | 104 | 114 | 124 | 134 | |
| 5 | 15 | 25 | 35 | 45 | 55 | 65 | 105 | 115 | 125 | 135 | |
| 6 | 16 | 26 | 36 | 46 | 56 | 66 | 106 | 116 | 126 | 136 | |
| 7 | 17 | 27 | 37 | 47 | 57 | 67 | 107 | 117 | 127 | 137 | |
| 8 | 18 | 28 | 38 | 48 | 58 | 68 | 108 | 118 | 128 | 138 | |
| 9 | 19 | 29 | 39 | 49 | 59 | 69 | 109 | 119 | 129 | 139 | |
| 10 | 20 | 30 | 40 | 50 | 60 | 70 | 110 | 120 | 130 | 140 | |

This service available only to U. S. and Canadian readers.

PLEASE PRINT — June 55-53

Name.....

Title.....

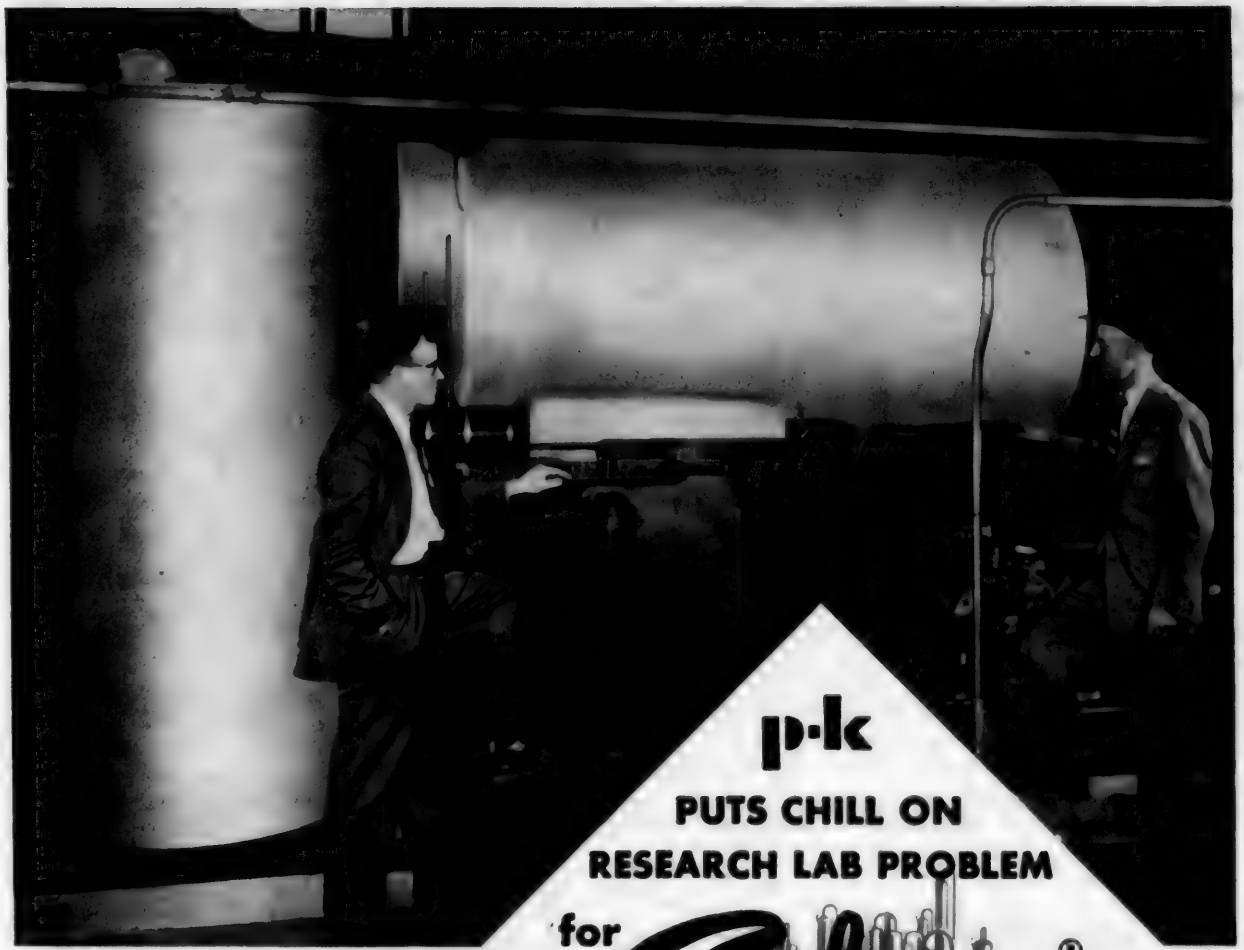
Firm.....

Address of Firm's Business.....

Zone..... State.....

City.....

This card is void after Sept. 1, 1955



# p·k PUTS CHILL ON RESEARCH LAB PROBLEM for Celanese® CHEMICALS

John Armstrong (right), president of Delta Engineering and Conditioning Co., East Orange, N. J., and A. G. Scott, Celanese plant engineer, discuss final details of the installation just prior to putting the system into service.

To solve a problem, first get to the center of it; and that's just what the engineers of Celanese and Delta Engineering did at the Celanese Corp. of America's Summit, N. J. research lab.

The nub of the problem called for controlled temperatures to be made available throughout the building for research and pilot plant work. The solution centers on a **p·k** brine storage chiller centrally installed in the basement. Around it is the system of the closed-circuit type, composed of compressor, pumps, brine make-up and mixing tanks, with all instruments and controls mounted in a centrally located control panel.

Elimination of the conventional, open roof tanks means a *clean* system, while careful integration of units ensures ease of maintenance. This compact **p·k** chiller installation, requiring only minimum insulation and floor space, *is factory assembled in the 780 gal. brine storage tank.* From here, brine is circulated throughout the building at −15°F. to −10°F., with Freon 22 used as the cooling medium.

We believe that you, like the Delta Engineering and Conditioning Co., will find it easy and profitable to work with **p·k** specialists in the design, manufacture and application of heat transfer equipment. Write for information.

**The Patterson-Kelley Co., Inc.**

960 Burson Street, East Stroudsburg, Penna.

2970

101 Park Avenue, New York 17 • Railway Exchange Building, Chicago 4 • 1700 Walnut Street, Philadelphia 3 • 96-A Huntington Avenue, Boston • and other principal cities.

# Thermal Stresses in Building Materials

**Stresses and strains in such materials as asphalt caused by temperature changes, an ionization anemometer, and a new type of open fire are discussed in this month's letter from our correspondent abroad.**

LONDON—"Curiouser and curiouser" Alice would undoubtedly have said again, if she had been alive today and seen some of the equipment being used for research in the heating, ventilating and allied fields. True enough, the accompanying illustration is of fairly conventional apparatus, and some people go so far as to decorate their rooms with sculptures and mobiles that perhaps do not look very different. But the illustration to a recent French paper is a photograph of a radio-telescope. And with good reason; it had actually been used in the research, besides being photogenic.

### Thermal Stresses in Building Materials

A radio-telescope is a large framework of girders out in the open air, supporting a number of wires, which no doubt all have a meaning for those who understand the science of the directional reception of low-frequency electro-magnetic waves from outer space. But G. E. Varlan saw the specimen at Meudon Observatory as an ideal research tool for determining the heat-exchange between various surfaces and their surroundings. The controls and gearing were such as to make it possible to point the telescope in almost any direction in space and to keep it there despite the rotation of the earth. Blocks of concrete with embedded thermocouples were surfaced with layers of asphalt, aluminium paint, and other finishes, and made to receive radiation from the sun in a perpendicular direction while the time-temperature relations were plotted.

With reliable figures for heat-exchange and surface temperatures found in this way, the author goes on to assess the strains and stresses in various materials such as asphalt, rubber and glass. (*Cahiers du Centre Scientifique et Technique du Batiment No.* 22. *Cahier* 202). In full sunshine, a roof made of 4 inches of concrete with about an inch of asphalt on top may attain a surface temperature of, say, 140 deg F with the underside of the concrete at about 82 deg. A sudden shower of rain out of this cloudless sky (this is a theoretical investigation) would chill the surface. Within 4 minutes the upper surface of the asphalt would be cooler than the junction between asphalt and concrete, where in such a short time there would have been little change. This reversal of temperature gradient strains the material, and if it has lost some of its elasticity with age cracking will begin, and the material ceases to be weatherproof.

### Climatic Research Laboratory, Farnborough

Farnborough is well-known, rightly or wrongly, as the place where the British aircraft industry shows off each year new varieties of aeroplanes that cannot be made in any quantity for at least another five years. It is also, apparently, the home of a little-known body called the Institute of Aviation Medicine. The doctors comprising this organization set two members of the Institution of Heating and Ventilating Engineers on the Air Ministry staff a pretty problem which they described recently in a paper to the Institution (*Journal*, Vol. 22, p. 201).

The specification called for a test chamber 9 ft by 9 ft by 15 ft long, in which extremes of atmospheric conditions could be simulated. The air was to be variable in temperature from 15 to 180 deg in humidity from a dew-point of —6 deg to as near as practicable 100% R.H. at the higher temperatures, and in velocity from 30 to 2,640 f.p.m. over the whole cross-section of the chamber. The doctors wanted to test positive and negative radiation from the walls, and the effects of sunshine and rainfall. The accuracy of control required was ± ½ deg in temperature, ± ½% R.H., and ± 1% of the air speed. In addition to the test chamber, three other rooms were required, for acclimatisation of the human subjects, for clothes conditioning and for clothes drying; these presented few problems in comparison with the test chamber conditions and control.

In the discussion on the paper the contractor said he would not like many more similar jobs. It was the only one in which he had not understood a great deal of what was going on and which was quite definitely beyond the designing capacity of his office. Testing was a big unknown in a job of this sort, and he did not see what could stop the client forcing the contractor to test *ad infinitum* in the case of a plant of such complexity. A. H. Coombs, one of the authors, said that even he did not always know what had been done, because small changes were sometimes made with the sub-contractors. Certainly nobody during the construction period could have foretold how it was all going to work. The major problem derived from the need for laboratory accuracy of control to be applied on full-scale plant with commercially available apparatus. Another difficulty of a fundamental nature derived from the wide ranges to be covered. Temperature control was not very difficult because the air was recirculated and the insulation was such that heat gains or losses were very small. But the control of relative humidity proved to be exceedingly difficult. The sensing element read directly in R.H. and produced a corresponding pressure-change in the pneumatic control system. At 15 deg an inaccuracy of 5% in R.H. represents 0.59 grains of moisture per lb of air; at 180 deg the same inaccuracy represents 227 grains per lb. The valve seat of the steam valve was moved the same distance whatever the temperature, and since the whole plant had to be sized for the maximum load, hunting of the controls at low loads was to be expected. These troubles were overcome by means of a hand-set coarse adjustment, leaving the automatic

(*Continued on page* 144)

# Get Allis-Chalmers Engineering help on PUMPS

It pays to rely on Allis-Chalmers for your air conditioning pump needs. Your Allis-Chalmers representative or distributor is an experienced, highly qualified specialist who will help you pre-engineer the setup — help you get the simplest possible layout that will be most effective.

### Get Immediate Delivery From Stock

Allis-Chalmers air conditioning pumps, in a complete range of types and sizes, are carried in stock by Regional Warehouses and Authorized Distributors throughout the country. Your representative will show you how to expedite pump selection and ordering. Contact him before you start your next job.

A-4623

Milwaukee 1, Wisconsin

**ALLIS-CHALMERS**

(*Continued from page* 142)

control only a small duty whatever the level required.

The general plan of the installation is a roughly oval tunnel, 9 ft. by 9 ft. square or 9 ft. diameter in cross-section made of ⅛ in. steel plate and heavily insulated with cork and kapok. The test chamber is part of the tunnel, and the air is circulated by means of a 120 in. axial flow fan on the outlet side. The space enclosed by the tunnel is used for the coolers, refrigeration plant, steam boiler and other ancillary equipment. The sizes of most items of equipment are given in the paper, together with summaries of the design calculations. The senior engineer on the project was L. C. C. Rayner.

### Measurement of Air Flow

One's feelings of freshness or of stuffiness depend on the stimulation or lack of stimulation of exposed areas of the skin, and in normal indoor conditions such stimulation depends mainly on variability in the motion of the air. It does not matter which direction the air moves in so long as it moves, and there has for some time been a need for an anemometer which was truly omnidirectional. The katathermometer, no longer used for the purpose for which it was originally introduced, is generally employed for such measurements, but it is slow in action. In consequence it only gives an average value for the air movement over the period of measurement, thus concealing much of the variation.

W. L. Welman and F. E. Lovelock have perfected an ionization anemometer, which is described in a recent paper in the *Journal* of the I.H.V.E. (Vol. 22, p. 421). The ionizing source is radium-gold foil, which is free from the dangers of the escape of radon or of polonium particles into the atmosphere. It emits alpha particles which have a powerful ionizing action but a short range. The foil is cut and pressed into two shapes similar to those used in making a tennis ball, and applied to the surface of a ½ in. diameter ball-bearing which is mounted on an ⅛ in. supporting rod.

This ionizing source is charged to a positive potential of at least 100 volts. It is surrounded by an open collecting frame of dia. 10 cm. which is just about the maximum range of the alpha particles. This is surrounded by a shield cage 15 cm. diameter, which is too far for the alpha particles to penetrate, but which serves to collect ions which miss the cathode frame and to protect the instrument from outside influences.

Special test room with free-standing open fire; air-temperature and globe thermometers suspended from gantry. (*Photo courtesy Journal of the Institute of Fuel*)

The current is a maximum at zero wind speed. As the air speed increases more ions miss the cathode frame and the current falls. A sensitive amplifier is needed, and this is described. The instrument is suitable for measuring velocities from 10 to 250 f.p.m. Results are given of an investigation of air movement in a room 10 ft by 10 ft, the air being stirred by an axial flow fan.

W. Baird of the Engineering Test Branch of the Ministry of Works was dissatisfied with known methods of measuring air quantities at grilles when balancing air-conditioning plants. In a paper to the I.H.V.E. (*Journal*, Vol. 22, p. 283) he describes an electric anemometer developed for this purpose. The necessity which mothered this invention was an air-conditioning installation comprising 1200 inlet grilles supplied from un-get-at-able ducts.

The air issuing from the grille is collected in a trumpet head and passed over fine nickel wire grids with a heater grid between them. All three grids are designed with the minimum resistance to air flow, the cross section of the part of the apparatus containing the grids being 10 in. by 8 in. (large head) or 6½+ in. by 8 in. (small head). The nickel wire grids each consist of a single length of 34 or 36 s.w.g. wire used as resistance thermometers and connected to a simple bridge circuit with a slide wire. With a constant heat input to the heater the temperature difference is inversely proportional to the air quantity, and a straight line calibration of air quantity against slide reading can be obtained on logarithmic paper.

### New Types of Open Fire

As a heating and ventilating appliance there is much to be said for the open coal fire. It is remarkably cheap in first cost when reckoned on the basis of maximum heat output. It produces adequate ventilation, and "fresh" conditions of a high MRT with cool air and good air movement. It can be sat by and watched as an alternative to television, and will be found remarkably free from advertising. On the other hand it is dirty, troublesome, thermally inefficient, and causes cold drafts round the ankles and the back of the neck.

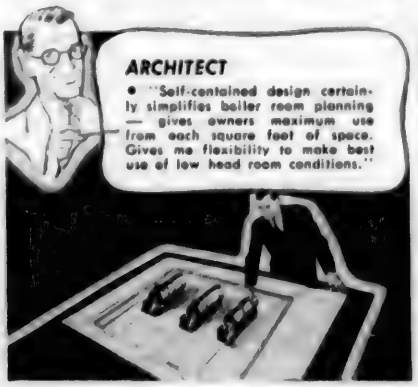
The British Coal Utilisation Research Association, which is an independent organization supported by financial contributions from the National Coal Board and coal users and carries out research into better use of coal, has been devoting some attention to this. An improved type of open fire, free-standing and giving some convected heat has been developed, and is now available commercially. The appliance can be seen in the illustration, in a furnished room in which its performance was being tested. Air passes round the back and sides of the metal appliance and becomes warmed; also the throat at the base of the chimney is restricted so that the air flow is only about 2000 cu. ft. per hr, as against the 7000 to 9000 of the ordinary open fire. If one attempts to cut down the airflow in an ordinary fire by throat restriction

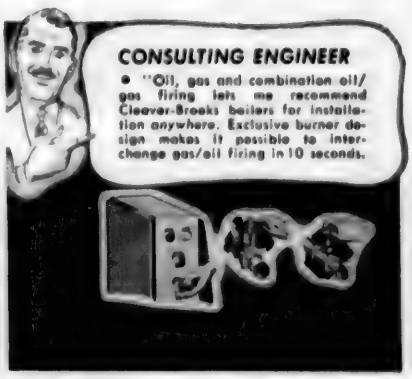
(*Concluded on page* 162)

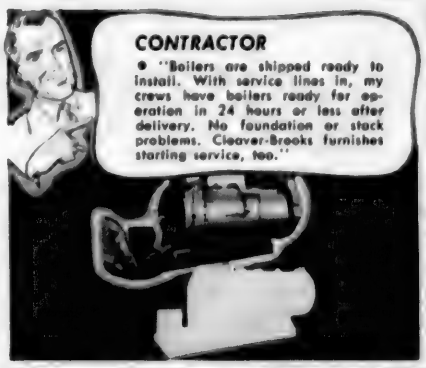
# CLEAVER-BROOKS SELF-CONTAINED BOILERS HAVE THE FEATURES EVERYONE WANTS!

## ...which feature would be most important to you?

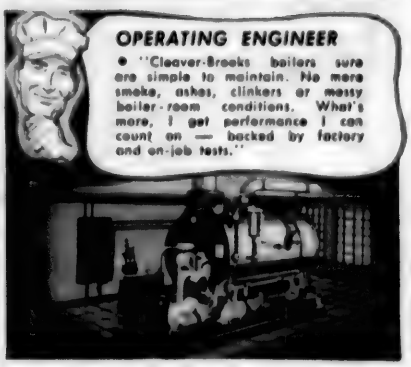
PLANT OWNER
• "Cleaver-Brooks boilers are tops in fuel economy! Forced-draft, four-pass construction and 5 sq. ft. of heating surface per boiler H.P. assure me 80% operating efficiency when firing with oil."

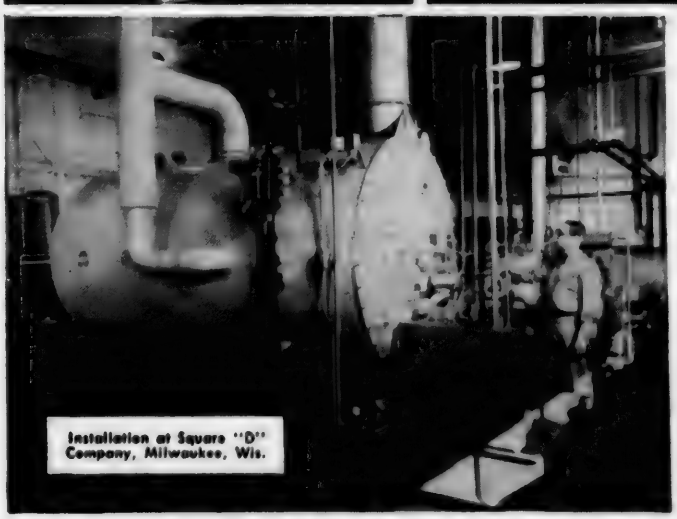

ARCHITECT
• "Self-contained design certainly simplifies boiler room planning — gives owners maximum use from each square foot of space. Gives me flexibility to make best use of low head room conditions."


CONSULTING ENGINEER
• "Oil, gas and combination oil/gas firing lets me recommend Cleaver-Brooks boilers for installation anywhere. Exclusive burner design makes it possible to interchange gas/oil firing in 10 seconds."


CONTRACTOR
• "Boilers are shipped ready to install. With service lines in, my crews have boilers ready for operation in 24 hours or less after delivery. No foundation or stack problems. Cleaver-Brooks furnishes starting service, too."

PLANT SUPERINTENDENT
• "I get all the steam I need for fluctuating steam demands, from full load down to 30% of rating. Automatic burner controls assure instant firing. I call that real dependability."


OPERATING ENGINEER
• "Cleaver-Brooks boilers sure are simple to maintain. No more smoke, ashes, clinkers or messy boiler-room conditions. What's more, I get performance I can count on — backed by factory and on-job tests."




THESE are just a few of the many outstanding features that have made more than 15,000 individual Cleaver-Brooks self-contained boilers *first choice* for commercial, institutional and industrial applications. Get in touch with your nearest Cleaver-Brooks representative for complete facts, or write for catalog AD-100. Cleaver-Brooks Co., Dept. G, 3 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. — *Cable address: CLEBRO — Milwaukee — all codes.*

**Cleaver Brooks**

***"It's NEW — get the facts on the CB boiler — write today!"***

**BOILERS — STEAM OR HOT WATER — FOR HEATING OR PROCESSING IN SIZES FROM 15 TO 500 HP, 15 TO 250 PSI.**

**NOW — FIRST SIZES OF THE CB BOILER ARE MADE IN CANADA, TOO.**

# What Would You Do?

**Replies to engineering and operating problems of interest to the industrial plant engineer**

Conducted by
NATHAN N. WOLPERT
Associate Editor

AN available supply of cool drinking water at accessible points in a plant is considered good industrial management. This water may be supplied through self-contained units or through a central system which may be either a closed or open type. The two types of central systems are described.

Should you have a problem that you would like to see treated in this department or if you have some comments that you would like to add to the discussion scheduled for the next issue, you are invited to write to the Editor.

## This Month's Problem

**Among the changes being planned for a four-story industrial plant engaged in light manufacturing and assembling, is a central refrigeration system for cooling drinking water. I hear management talking about an open type system and a closed type system. What are some outstanding facts about each? What are the advantages or disadvantages of the two designs?**

### Discussion of the Problem

In a closed circulating system, the circulating pump, generally of a centrifugal type, keeps the lines filled with cold water so that when an outlet is opened, there is almost an immediate flow of chilled water. With this type system, it is not necessary to run the water for several minutes to bleed off the warm water. One of several types of evaporators may be used.

In one closed type system, the warm water is pumped through a coil located in the lower portion of a brine tank, and the outlet from this coil is connected to the vertical riser leading to each drinking fountain. In the upper portion of the brine tank, is placed a refrigerant evaporator coil. The refrigerator system keeps the brine cool. Water is cooled in one water cooler and is then circulated by a pump to the various bubblers. It was one of the first distributing systems used to deliver cool drinking water and it is still being used in buildings such as hospitals where an absolutely quiet system is desired, and in buildings where refrigerant lines cannot be run through the buildings because of code restrictions.

The circulating system consists, in general, of a condensing unit, a water cooler of one type or another, a circulating pump, a number of water bubblers together with the necessary insulated piping for distributing the chilled water to the bubblers. The system must have some provision for venting the air from the system and this vent is usually installed at the highest points in the system.

There is one closed type system in which the warm water enters a storage tank which is surrounded by a refrigerant coil. The tank containing the stored drinking water and the refrigerant coil surrounding the tank are located in a large insulated container filled with fresh water (water without salt). From the lower part of the tank containing the stored water, a line leads to an additional coil located in the water bath. This bath and the drinking water storage tank furnish a large amount of hold-over which can carry the cooling load during peak periods. With this system, the size of the refrigeration machine can be appreciably reduced. This means a lower cost for the refrigeration unit.

Both the open and close type systems are similar and differ only in that the closed system is under pressure at all times while the open system is open to the atmosphere. In the closed system, the make-up water is fed into the suction side of the pump; in the open system the make-up water is fed into an open tank cooler under the control of a float valve.

The open type system may or may not have a circulating pump. One design installs the system on the top floor so that water may flow from the open type tank to the various bubblers by gravity. If a pump is used, water flows from the open tank cooler to the circulating pump which forces it through the distribution system. The pump must deliver the water with sufficient pressure to lift the water to the top of the system and to force the water through the highest outlet and overcome pipe friction losses.

Frequently the tank cooler is placed at the highest point of the system, in which case a pump need not be used. A float is used in the open storage tank and water flows downward by gravity to the various outlets on the floors below.

(*Concluded on page* 148)

## Problem for the Coming Issue

**We have the job of welding nickel alloy tube that has light wall thickness. There seems to be some difference of opinion as to how these tubes should be welded. Information is wanted on the method to use and what practices should be followed in making this weld.**

# Want control for Water Heaters or Heat Exchangers?

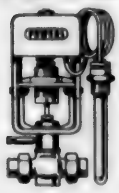
# call POWERS

**FLOWRITE**
One of Powers Premium Quality Diaphragm Control Valves. They're simple, sturdy and dependable.

Over 60 Years of Temperature and Humidity Control

(c28a)

**You Will Insure Better Temperature Control IF—** you use the right type regulator and proper size control valve. Whether a simple self-operating regulator shown at left is required or the air operated controls featured here . . . you can get both types and others from Powers. For further information call or write our nearest office.



**Powers ACCRITEM Temperature Regulator and FLOWRITE Valve**—the right combination for many control problems where pressure and load conditions fluctuate widely, also for control of large size valves.

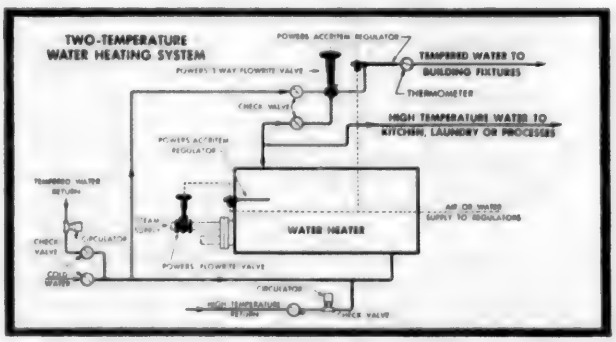
Over 50 Years Experience making this type of regulator

Control Point easily changed

Air or water operated

Ranges 50 to 250°F—150 to 350°F

**VALVES:** Available in a variety of body types and inner valves.

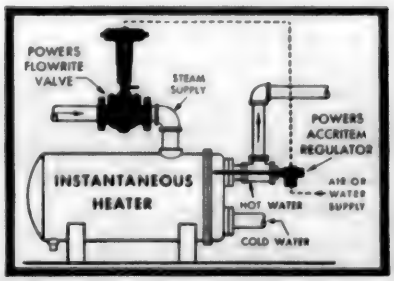


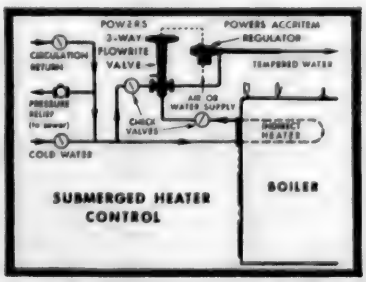

## ACCRITEM TEMPERATURE REGULATOR

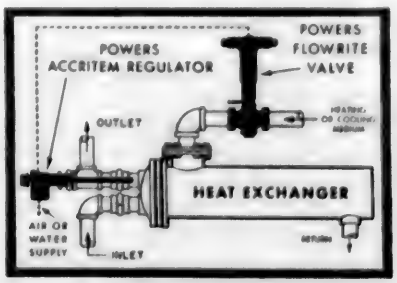
Gives Close Control and Years of Dependable Service.

- Has Adjustable Throttling Range and Calibrated Dial.
- Simple, Durable Construction assures years of trouble-free service.
- Easy to Install • Direct or Reverse Acting, reversible on the job.
- Small Size: Regulator head is 2⅞" wide, 3⅛" high, bulb is 12" long with ½" IPS Connection.

***Fully Described in Bulletin 316. Write for a copy.***



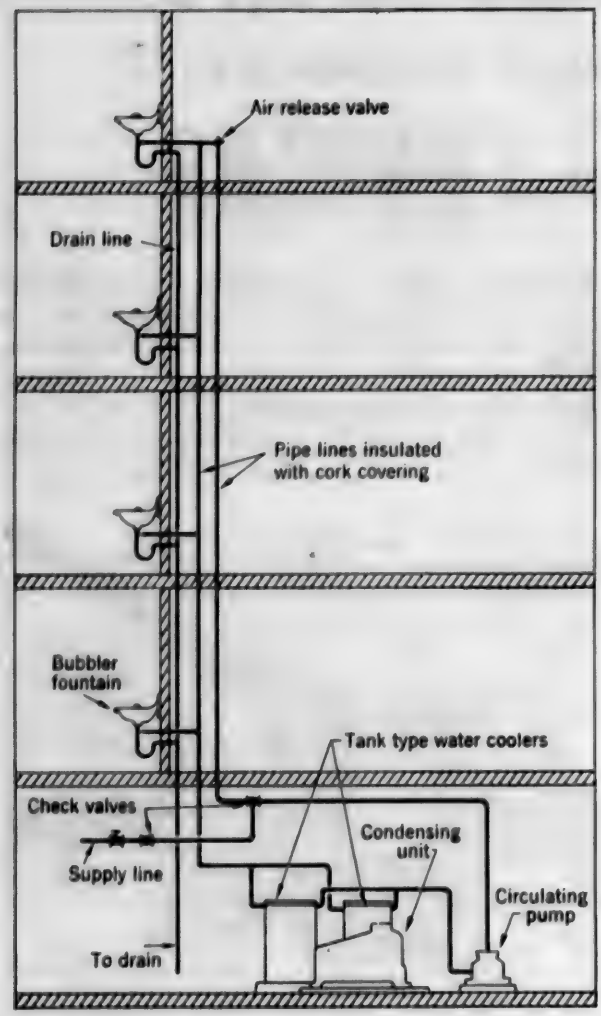




**THE POWERS REGULATOR COMPANY** | Skokie, Ill. • Offices in Principal Cities, U. S. A. Also Canada and Mexico • See your phone book

## WHAT WOULD YOU DO?

*(Concluded from page 146)*




This closed circuit provides cool water almost immediately.

Where there is a heavy intermittent demand for cool drinking water, an open type circulating system may be used. The advantages of such a system are:

1. The condensing unit is usually small, as the stored cold water is sufficient to take care of intermittent peak demands.
2. There is very little or no danger of a freeze-up.
3. An arrangement can be made for the water to flow by gravity, thus eliminating the pump and the possible service problems connected with the use of a pump.

Peak loads can easily be taken care of by the ice stored around the refrigerant coil. The refrigerant temperature controls the formation of the amount of ice accumulating around the refrigerant coil. The water coil can be placed on the opposite side in an open tank in which the water level is controlled by a float, or it can be placed in the center, surrounded by the ice-coated refrigerant coil. As the water is drawn off from any of the fountains, fresh water enters the tank. By spilling this fresh, incoming water over the ice cake, some of the ice is melted off. The amount of water entering is equal to the amount drawn off.

For this information, thanks are due to Joseph Askin, an engineer who has had extensive experience with such systems.

*The following reply is in answer to a previous question regarding the making of a survey to see that the many pumps operating in a chemical plant are being used properly. Selection data were requested.*

There are many improperly applied pumps in use today. In addition to the approach you are suggesting, I should like to present another approach which is of great benefit in a large plant.

When a chemical plant or refinery is being built, one of the prime considerations is the amount of money that must be invested in spare parts to insure 100% availability of each pumping unit. Furthermore, a high percentage of the pumps in many plants are small in size with fairly low efficiencies. Instead of selecting a large number of different types of small pumps for these services, I favor the practice of selecting a pump that most nearly fills the requirements of all of the services and standardizes on this pump. The wasted horsepower might be 10% of one horsepower, the cost of which is negligible compared to the cost of stocking parts for the more efficient pump. Of course, when the horsepower requirements of the pumps are large or when the pumping job is particularly difficult, individually selected pumps will offer the cheapest unit over a period of years.

This opinion is being presented to you in the hope that it might be of value to others who wish to standardize their installation to effect lower over all operating costs.

*D. R. Keck*
*Chairman, Standards Program*
*Celanese Corporation of America*
*Charlotte, N. C.*

## Thermostat Made for Blind Couple

A sightless couple are now able to enjoy the same fingertip control of temperatures in their new home as their more fortunate neighbors. A thermostat which can be read by touch has been specially built.

The home in Cloquet, Minn., is being built and furnished through donations from the community for a young veteran who lost his sight while fighting in Korea and for his bride, who has been sightless since she was 13 years old.

To give them automatic control over the operation of the heating plant in their new home, engineers at Minneapolis-Honeywell adapted one of their round thermostats so it can be easily adjusted by touch. To obtain the desired temperature it is necessary only to align a notch in the knurled plastic setting ring with one of the three tiny buttons installed on the cover. The buttons correspond with 60, 70 and 80 deg F thermostat settings.

The instrument, donated by the company, will control the operation of an oil furnace being installed by local heating and plumbing contractors.

**EVERY WORTHINGTON PACKAGED LIQUID CHILLER** (in sizes up to 200 hp) is factory assembled, tested, and shipped as one complete package.

# Low-cost operation, easy installation . . .

## you get both with Worthington's new packaged liquid chiller

If you're interested in process cooling, refrigeration, or air conditioning, take a long look at these six big advantages of the new Worthington packaged liquid chillers:

**LOW-COST OPERATION** — Simple variable capacity control exactly matches load requirements — results in unusually economical operation.

**EASY INSTALLATION** — All units are shipped completely assembled. Only simple foundations are needed.

**FACTORY ENGINEERING** — You benefit from Worthington's undivided manufacturing responsibility. Worthington makes everything — compressor, chiller, drive and controls.

**MINIMUM FLOOR SPACE** — Efficient, compact design means greatly reduced space requirements.

**LONG LIFE** — over a million dollars worth of research went into Worthington's Freon compressor — all aimed at making it the most durable unit ever.

**WIDE SELECTION** — No matter what you want to chill — water or brine — you can get a Worthington packaged liquid chiller that's exactly right for the job. Sizes from 7½ all the way up to 200 hp.

Want more facts? Mail the coupon today for Bulletin C-1100-B52. It tells all about specifications, features, and typical applications. A.S.58-V

**WORTHINGTON**

*Climate Engineers to Industry, Business and the Home*

**Worthington Corporation**
**Air Conditioning and Refrigeration Division**
**Harrison, N.J.**

**Gentlemen:**
Please send me your new Bulletin C-1100-B52 on Worthington Liquid Chillers.

Name_____

Address_____

City_____ Zone____ State_____

# DEGREE-DAYS FOR APRIL, 1955

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 27th Year of Publication of Monthly Degree-Day Data

| City | April | | | Season to Apr. 30, incl.* | | |
|---|---|---|---|---|---|---|
| | 1955 | 1954 | Normal | 1954-55 | 1953-54 | Normal |
| Abilene, Texas (A) | 72 | 30 | 113 | 2265 | 2281 | 2707 |
| Albany, New York (A) | 455 | 498 | 597 | 6322 | 6012 | 6642 |
| Albuquerque, New Mexico (A) | 292 | 96 | 289 | 4157 | 3726 | 4319 |
| Alpena, Michigan (C) | 562 | 714 | 762 | 6968 | 6770 | 7366 |
| Anaconda, Montana (C) | (a) | 765 | 756** | (a) | 6595 | 6737** |
| Asheville, North Carolina (C) | 182 | 136 | 285 | 4031 | 3672 | 3962 |
| Atlanta, Georgia (A) | 56 | 65 | 133 | 2751 | 2583 | 2806 |
| Atlantic City, New Jersey (C) | 402 | 401 | 468 | 4474 | 4038 | 4528 |
| Augusta, Georgia (A) | 65 | 56 | 62 | 2536 | 2291 | 2138 |
| Baltimore, Maryland (C) | 203 | 185 | 326 | 3994 | 3524 | 4130 |
| Billings, Montana (A) | 606 | 661 | 564 | 6470 | 6037 | 6655 |
| Binghamton, New York (C) | 411 | 442 | 570 | 5961 | 5704 | 6232 |
| Birmingham, Alabama (A) | 50 | 55 | 128 | 2684 | 2543 | 2758 |
| Bismarck, North Dakota (A) | 475 | 726 | 657 | 7854 | 7602 | 8496 |
| Block Island, Rhode Island (A) | 564 | 563 | 603 | 5161 | 4744 | 5385 |
| Boise, Idaho (A) | 621 | 447 | 453 | 6113 | 4912 | 5549 |
| Boston, Massachusetts (A) | 469 | 442 | 534 | 5262 | 4837 | 5506 |
| Bozeman, Montana (C) | (a) | 631 | 731** | (a) | 6617 | 7724** |
| Buffalo, New York (A) | 414 | 524 | 636 | 5944 | 5708 | 6405 |
| Burlington, Iowa (A) | 219 | 324 | 425 | 5563 | 5229 | 5888 |
| Burlington, Vermont (A) | 557 | 644 | 681 | 7184 | 6789 | 7420 |
| Butte, Montana (C) | (a) | 699 | 741** | (a) | 6842 | 7424** |
| Cairo, Illinois (C) | 73 | 100 | 182 | 3531 | 3391 | 3709 |
| Charleston, South Carolina (C) | 31 | 29 | 43 | 1822 | 1586 | 1769 |
| Charlotte, North Carolina (A) | 84 | 112 | 172 | 3081 | 3897 | 3176 |
| Chattanooga, Tennessee (A) | 80 | 59 | 179 | 3270 | 3063 | 3339 |
| Cheyenne, Wyoming (A) | 659 | 550 | 717 | 5990 | 5966 | 6855 |
| Chicago, Illinois (C) | 294 | 379 | 518** | 5257 | 4966 | 5764** |
| Cincinnati, Ohio (C) | 144 | 164 | 314 | 4069 | 3846 | 4424 |
| Cleveland, Ohio (A) | 268 | 327 | 531 | 5253 | 5050 | 5727 |
| Columbia, Missouri (A) | 121 | 185 | 326 | 4467 | 4247 | 4958 |
| Columbia, South Carolina (A) | 47 | 51 | 77 | 2604 | 2068 | 2284 |
| Columbus, Ohio (C) | 243 | 234 | 408 | 4791 | 4242 | 5102 |
| Concord, New Hampshire (A) | 578 | 579 | 660 | 6695 | 6333 | 7146 |
| Concordia, Kansas (C) | 177 | 227 | 341 | 4869 | 4543 | 5157 |
| Dallas, Texas (A) | 52 | 26 | 75 | 2146 | 2111 | 2272 |
| Dayton, Ohio (A) | 237 | 278 | 435 | 5120 | 4555 | 5373 |
| Deer Lodge, Montana (C) | (a) | 686 | 735** | (a) | 6672 | 7860** |
| Denver, Colorado (A) | 444 | 333 | 525 | 5555 | 4776 | 5765 |
| Des Moines, Iowa (A) | 236 | 352 | 438 | 5882 | 5568 | 6183 |
| Detroit, Michigan (A) | 311 | 442 | 558 | 5639 | 5448 | 6085 |
| Devils Lake, North Dakota (C) | 509 | 818 | 750 | 8803 | 8509 | 9301 |
| Dodge City, Kansas (A) | 214 | 226 | 347 | 4532 | 4328 | 4908 |
| Dubuque, Iowa (A) | 334 | 452 | 543 | 6600 | 6202 | 6892 |
| Duluth, Minnesota (C) | 597 | 842 | 801 | 8591 | 8299 | 8730 |
| Elkins, West Virginia (A) | 345 | 285 | 477 | 5496 | 5246 | 5456 |
| El Paso, Texas (A) | 64 | 17 | 110 | 2521 | 2421 | 2641 |
| Ely, Nevada (A) | 765 | 560 | 639 | 7491 | 6420 | 6759 |
| Escanaba, Michigan (C) | 580 | 748 | 804 | 7298 | 7091 | 7863 |
| Evansville, Indiana (A) | 157 | 165 | 251 | 4226 | 4036 | 4264 |
| Fargo, North Dakota (A) | 424 | 711 | 687 | 8448 | 8108 | 8769 |
| Fort Smith, Arkansas (A) | 82 | 54 | 127 | 3096 | 3080 | 3164 |
| Fort Wayne, Indiana (A) | 264 | 346 | 516 | 5521 | 5244 | 5991 |
| Fort Worth, Texas (A) | 57 | 28 | 90 | 2193 | 2195 | 2356 |
| Fresno, California (A) | 300 | 98 | 145 | 2952 | 2487 | 2489 |
| Galveston, Texas (C) | 9 | 10 | 30 | 990 | 1015 | 1211 |
| Grand Junction, Colorado (A) | 475 | 248 | 402 | 5982 | 3833 | 5628 |
| Grand Rapids, Michigan (A) | 358 | 471 | 606 | 6112 | 5866 | 6647 |
| Green Bay, Wisconsin (A) | 479 | 592 | 696 | 7391 | 6836 | 7715 |
| Greensboro, North Carolina (A) | 136 | 150 | 241 | 3765 | 3454 | 3760 |
| Greenville, South Carolina (A) | 77 | 89 | 161 | 3092 | 2745 | 3028 |
| Harrisburg, Pennsylvania (A) | 291 | 295 | 423 | 4939 | 4616 | 5116 |
| Hartford, Connecticut (A) | 449 | 446 | 528 | 5654 | 5188 | 5893 |
| Hatteras, North Carolina (C) | 114 | 97 | 171 | 2496 | 1924 | 2367 |
| Havre, Montana (C) | 711 | 825 | 597 | 7273 | 7188 | 7717 |
| Helena, Montana (A) | 767 | 746 | 654 | 7775 | 6685 | 7606 |
| Houston, Texas (C) | 18 | 10 | 27 | 1134 | 1108 | 1276 |
| Huron, South Dakota (A) | 311 | 546 | 558 | 7131 | 6954 | 7517 |
| Indianapolis, Indiana (A) | 235 | 261 | 432 | 5118 | 4762 | 5405 |
| Jackson, Mississippi (A) | 46 | 33 | 81 | 2233 | 2081 | 2202 |
| Kansas City, Missouri (A) | 108 | 172 | 292 | 4294 | 4107 | 4769 |
| Knoxville, Tennessee (A) | 109 | 80 | 196 | 3513 | 3277 | 3540 |
| La Crosse, Wisconsin (A) | 326 | 463 | 552 | 6906 | 6311 | 7295 |

(a) Data not available.

*Heating season, cumulative, from Sept. 1.

**Same normal figures as previously listed by HEATING AND VENTILATING since new figures are not available. All other normal figures in this table are based on a 30-year period covering 1921 to 1950, inclusive, recently compiled and published by the U. S. Weather Bureau.

Figures in this table, with eight exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively; Anaconda, Bozeman, Butte, Deer Lodge and Livingston, Mont., through the courtesy of the Montana Power Company. Tacoma figures through the courtesy of the Tacoma News Tribune.

[Table concluded on page 152]

BARBER COLMAN

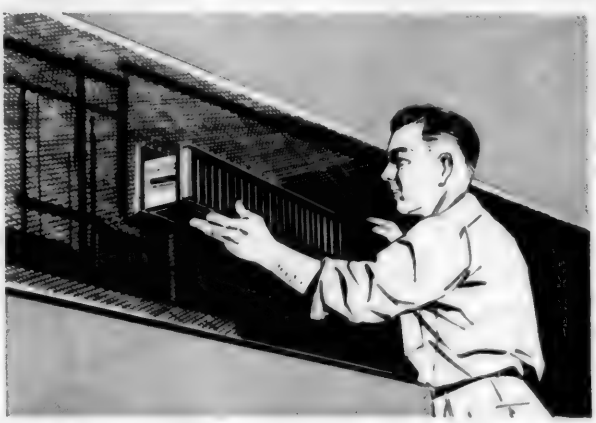
# uni-flo Engineered Air Distribution

## High velocity for space-saving air distribution

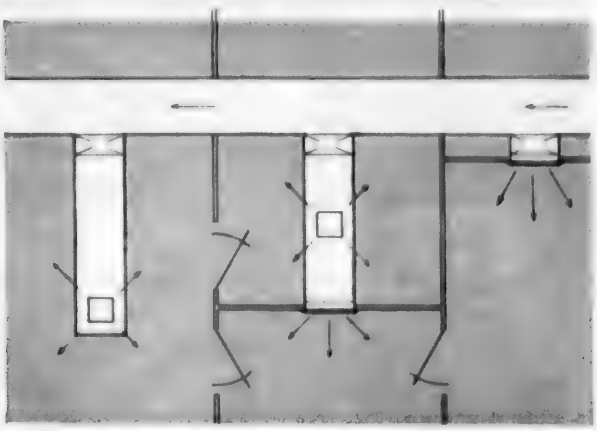
Contemporary design of the new Texas Eastern Transmission Corporation office building contributes to the beauty of the Shreveport, Louisiana skyline. This modern 14-story building is the home office of an organization which, in less than a decade, has become one of the major natural gas transmission companies in the country. Individual room fan coil units, using chilled and hot water, provide year-round air conditioning. Outside air for ventilation is supplied through a space-saving high velocity system.

**Attractive appearance** of the Barber-Colman air distribution equipment appealed to the architect. Uni-Flo Sidewall Diffusers provide efficient distribution of the air, free from drafts and disturbing noise. Each diffuser is individually adjustable for simplified balancing of the system.

Texas Eastern Transmission Corporation Office Building, Shreveport. *Architects:* NEILD-SOMDAL-ASSOCIATES, Shreveport. *Consulting Engineers:* CARY B. GAMBLE & ASSOCIATES, New Orleans. *General Contractor:* J. A. JONES CONSTRUCTION CO., Shreveport. *Mechanical Contractors:* HUFFMAN-WOLFE SOUTHERN CORP., Atlanta.



**Uni-Flo Air Valve** can be installed directly behind the grille to reduce high velocity air to conventional velocity for distribution. Air valve is adjustable through grille opening.



Flexibility of Uni-Flo Air Valve permits installation at junction of high velocity trunk ducts with conventional velocity branch ducts to supply several diffusers.

## BLAZING THE TRAIL TO BETTER AIR DISTRIBUTION

***First* with high velocity air valves, accessories**

Since 1947, when Barber-Colman introduced the Uni-Flo Air Valve (used in the above office building), the space-saving benefits of high velocity air distribution have encouraged applications throughout the nation. High velocity makes the use of smaller ducts possible. The patented air valve transforms high velocity air to low velocity near point of room entry, with minimum turbulence and noise. Engineering help on high velocity applications is yours by calling our nearby Field Office, or writing us.

**Barber-Colman Company**

**Dept. R, 1102 Rock Street, ROCKFORD, ILLINOIS, U. S. A.**

***Field Offices in Principal Cities***

Air Distribution Products • Automatic Controls • Industrial Instruments
Aircraft Controls • Small Motors • Overdoors and Operators • Molded Products • Metal Cutting Tools • Textile Machinery

# Degree-Days for April, 1955 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city.

AIR CONDITIONING, HEATING AND VENTILATING's 27th Year of Publication of Monthly Degree-Day Data

| City | April | | | Season to Apr. 30, incl.* | | |
|---|---|---|---|---|---|---|
| | 1955 | 1954 | Normal | 1954-55 | 1953-54 | Normal |
| Lander, Wyoming (A) | 706 | 539 | 687 | 7227 | 6336 | 7714 |
| Lewiston, Maine (O) | 573 | 670 | 693** | 6756 | 6660 | 7318** |
| Lincoln, Nebraska (C) | 188 | 304 | 377 | 5384 | 5089 | 5654 |
| Little Rock, Arkansas (A) | 59 | 51 | 122 | 2846 | 2732 | 2964 |
| Livingston, Montana (C) | (a) | 673 | 653** | (a) | 6300 | 6638** |
| Los Angeles, California (C) | 128 | 120 | 129 | 1162 | 1055 | 1364 |
| Louisville, Kentucky (A) | (a) | 163 | 285 | (a) | 3906 | 4340 |
| Lynchburg, Virginia (A) | 176 | 182 | 289 | 4056 | 3715 | 4066 |
| Macon, Georgia (A) | 30 | 36 | 62 | 2158 | 1984 | 2049 |
| Madison, Wisconsin (C) | 331 | 466 | 573 | 6571 | 6084 | 6915 |
| Marquette, Michigan (C) | 542 | 754 | 789 | 7294 | 7010 | 7707 |
| Memphis, Tennessee (A) | 64 | 68 | 139 | 2038 | 2834 | 3113 |
| Meridian, Mississippi (A) | 50 | 37 | 85 | 2371 | 2226 | 2324 |
| Milwaukee, Wisconsin (A) | (a) | 516 | 621 | (a) | 5947 | 6693 |
| Minneapolis, Minnesota (A) | 328 | 553 | 570 | 7285 | 6824 | 7489 |
| Moline, Illinois (A) | 236 | 355 | 453 | 5846 | 5487 | 6112 |
| Montgomery, Alabama (A) | 34 | 29 | 80 | 2218 | 2026 | 2137 |
| Nantucket, Massachusetts (A) | 633 | 599 | 642 | 5305 | 4923 | 5513 |
| Nashville, Tennessee (A) | 91 | 91 | 186 | 3514 | 3284 | 3470 |
| New Haven, Connecticut (A) | 473 | 484 | 567 | 5398 | 5115 | 5695 |
| New Orleans, Louisiana (C) | 15 | 8 | 19 | 1116 | 1079 | 1175 |
| New York, New York (C) | 362 | 360 | 456 | 4724 | 4224 | 4879 |
| Newark, New Jersey (A) | 346 | 358 | 450 | 4785 | 4441 | 5093 |
| Norfolk, Virginia (A) | (a) | 175 | 265 | (a) | 2996 | 3395 |
| North Platte, Nebraska (A) | 371 | 414 | 489 | 6330 | 5766 | 6227 |
| Oakland, California (A) | 415 | 193 | 282 | 2885 | 2398 | 2671 |
| Oklahoma City, Oklahoma (A) | 117 | 79 | 169 | 3382 | 3149 | 3481 |
| Omaha, Nebraska (A) | 180 | 309 | 389 | 5527 | 5177 | 5948 |
| Parkersburg, West Virginia (C) | (a) | 193 | 347 | (a) | 4178 | 4618 |
| Peoria, Illinois (A) | 190 | 304 | 435 | 5419 | 5131 | 5843 |
| Philadelphia, Pennsylvania (C) | 285 | 288 | 369 | 4304 | 3896 | 4430 |
| Phoenix, Arizona (A) | 37 | 7 | 62 | 1433 | 1353 | 1492 |
| Pittsburgh, Pennsylvania (C) | 202 | 238 | 402 | 4629 | 4332 | 4898 |
| Pittsfield, Mass. (A) | 555 | 570 | 690 | 6854 | 6482 | 7165 |
| Pocatello, Idaho (A) | 710 | 508 | 561 | 7342 | 5724 | 6523 |
| Portland, Maine (A) | 629 | 654 | 693 | 6698 | 6509 | 7099 |
| Portland, Oregon (C) | 517 | 405 | 347 | 4045 | 3641 | 3847 |
| Providence, Rhode Island (A) | 481 | 459 | 570 | 5448 | 5163 | 5783 |
| Pueblo, Colorado (A) | 377 | 246 | 456 | 5158 | 4495 | 5479 |
| Raleigh, North Carolina (A) | 109 | 110 | 172 | 3372 | 2858 | 3046 |
| Rapid City, South Dakota (A) | 451 | 565 | 615 | 6452 | 5922 | 6974 |
| Reading, Pennsylvania (C) | 277 | 281 | 411 | 4711 | 4346 | 4921 |
| Red Bluff, California (A) | 355 | 129 | 177 | 2970 | 2402 | 2495 |
| Reno, Nevada (A) | 702 | 432 | 519 | 6058 | 5092 | 5465 |
| Richmond, Virginia (A) | 155 | 183 | 271 | 3805 | 3478 | 3889 |
| Rochester, New York (A) | 420 | 534 | 615 | 6147 | 5867 | 6477 |
| Roswell, New Mexico (A) | 149 | 63 | 185 | 3381 | 3129 | 3396 |
| Sacramento, California (C) | 308 | 126 | 196 | 2863 | 2355 | 2510 |
| St. Joseph, Missouri (A) | 157 | 222 | 297 | 5001 | 4665 | 4591 |
| St. Louis, Missouri (C) | 88 | 155 | 270 | 4087 | 3764 | 4368 |
| Salt Lake City, Utah (A) | 572 | 835 | 453 | 6132 | 4877 | 5552 |
| San Antonio, Texas (A) | 14 | 8 | 34 | 1223 | 1370 | 1579 |
| San Diego, California (A) | 158 | 116 | 151 | 1223 | 1103 | 1416 |
| Sandusky, Ohio (C) | 254 | 337 | 513 | 5173 | 4863 | 5601 |
| San Francisco, California (C) | 374 | 232 | 279 | 2488 | 2096 | 2275 |
| Sault Ste. Marie, Michigan (A) | 611 | 841 | 846 | 7989 | 7835 | 8517 |
| Savannah, Georgia (A) | 40 | 29 | 43 | 2020 | 1693 | 1710 |
| Scranton, Pennsylvania (A) | 362 | 391 | 516 | 5611 | 5218 | 5798 |
| Seattle, Washington (C) | 525 | 482 | 396 | 4123 | 3905 | 3991 |
| Sheridan, Wyoming (A) | 629 | 640 | 645 | 7004 | 6370 | 7287 |
| Shreveport, Louisiana (A) | 34 | 27 | 61 | 2042 | 2009 | 2117 |
| Sioux City, Iowa (A) | 220 | 416 | 474 | 6176 | 5989 | 6705 |
| Spokane, Washington (A) | (a) | 640 | 561 | (a) | 5852 | 6331 |
| Springfield, Illinois (A) | 167 | 220 | 350 | 4995 | 4441 | 5084 |
| Springfield, Missouri (A) | 140 | 125 | 295 | 4217 | 3947 | 4551 |
| Syracuse, New York (A) | 400 | 503 | 570 | 6161 | 5800 | 6207 |
| Tacoma, Washington (C) | 526 | 459 | 435 | 4287 | 3944 | 4313 |
| Toledo, Ohio (A) | 288 | 393 | 555 | 5595 | 5360 | 6077 |
| Topeka, Kansas (C) | 129 | 171 | 295 | 4530 | 4200 | 4794 |
| Trenton, New Jersey (C) | 322 | 322 | 429 | 4740 | 4332 | 4924 |
| Utica, New York (O) | 445 | 542 | 588** | 6593 | 6217 | 6543** |
| Valentine, Nebraska (C) | 375 | 497 | 543 | 6405 | 5851 | 6683 |
| Walla Walla, Washington (C) | 503 | 387 | 338 | 4772 | 4189 | 4639 |
| Washington, D. C. (C) | 197 | 191 | 314 | 4013 | 3645 | 4178 |
| Wichita, Kansas (A) | 147 | 139 | 280 | 4189 | 3989 | 4463 |
| Williston, North Dakota (C) | 529 | 803 | 663 | 7876 | 7748 | 8499 |
| Winnemucca, Nevada (A) | 709 | 462 | 546 | 6786 | 5473 | 5942 |
| Yakima, Washington (A) | 631 | 518 | 408 | 5797 | 5325 | 5580 |

For footnotes, see page 150.

# CONCEAL-X

## THE NEW AIR CONDITIONING UNIT THAT REQUIRES NO FLOOR SPACE

*for*
**MOTELS**
**HOTELS**
**HOMES**
**OFFICES**
**HOSPITALS**
**and**
**General Buildings**

Conceal-X is built to save you money, make you money, and to better satisfy your customer. It is a real space saver designed for use in out of the way places and with the capacity to do a big job *quietly*. Recommended for motels, dwellings and buildings for Winter-Summer air conditioning. Conceal-X, installed in vestibules, overhead entrance ways, plenums, closets or hallways with or without false or furred ceilings, provides horizontal discharge to one or several adjacent rooms. Best of all, Conceal-X incorporates the Peerless patent-applied-for Hi-F finned construction that gives you greater B.T.U. efficiency year after year. May we send you bulletin and specifications?

**PEERLESS OF AMERICA, INC.**

MANUFACTURERS OF REFRIGERATION AND AIR CONDITIONING COILS SINCE 1912

Dept. A, 6200 N. PULASKI ROAD, CHICAGO 30, Ill., U.S.A.

# NEWS OF THE MONTH

## INDUSTRIAL HEALTH CONFERENCE

**draws record attendance at meetings in Buffalo. Governor proclaims Industrial Health Week.**

More than 3,000 physicians, nurses, hygienists, and dentists from the United States and Canada, concerned with the preservation of health and well-being of industrial employees, held their 1955 Industrial Health Conference at the Memorial Auditorium and Hotel Statler in Buffalo April 23 to 29.

Participating in the meetings and discussions were the Industrial Medical Association, American Associaton of Industrial Dentists, American Association of Industrial Nurses, American Industrial Hygiene Association, and American Conference of Governmental Industrial Hygienists. Theme for the Conference was "Team Work" acknowledging the need for close collaboration of the five groups in their endeavor to protect employees' health.

In recognition of the importance of the work being done in preserving the health and welfare of Americans employed in industry, Governor Harriman proclaimed the week of April 25 as Industrial Health Week in the State of New York, coinciding with the Conference.

• **LAUNCHING.**—The American Conference of Governmental Industrial Hygienists opened its general session on Monday with a discussion of occupational health in the diatomite producing industry, while the American Industrial Hygiene Association arranged industrial hygiene tours to several plants in the Buffalo area, preparing to start its general session Tuesday with a discussion of toxicology of plastics.

The Industrial Medical Association began the day with group meetings and plant visits, and continued Tuesday morning with clinical teaching sessions at the University of Buffalo School of Medicine. The American Association of Industrial Nurses opened their meetings Monday morning with a discussion of the topic "Setting our Sights on Industrial Nursing Education." The American Association of Industrial Dentists began meetings on Tuesday.

• **EXHIBITS.**—Technical and scientific exhibits of 105 organizations attracted thousands of registered visitors and included an exhibit of the three latest models of atomic reactors from the Oak Ridge laboratories, as well as exhibits of medications, appliances, instruments, and information sources pertinent to industrial health.

• **THRESHOLD LIMITS.**—The Tuesday morning session of ACGIH began with a discussion of silicosis incidence in the Barre, Vermont, granite industry. This group wound up its meeting in the afternoon in a joint session with AIHA discussing chiefly the various aspects of threshold limits.

"No method ever has been, or ever can be, devised that will permit an exact advance prediction of human hazard. Threshold limits, no matter how accurate and well-documented, serve only as a guide and a yardstick," Miriam Sachs, M.D., of the New Jersey Department of Health, told the two assembled groups.

In substantiating her statement, Dr. Sachs quoted from a preface to a list of threshold limits compiled by ACGIH in 1948 which stated that "people vary greatly in their response to drugs and toxic substances. Therefore, it is a figment of the imagination to think that we can set down a precise limit below which there is complete safety and immediately above which there may be a high percentage of cases of poisoning among those exposed. The values have been set at a level below which it is fair to expect reasonable protection and above which it is reasonable to expect occasional cases of poisoning."

In spite of such an elastic yardstick now in use, Dr. Sachs believes that it is nevertheless extremely useful, submitting as an example that "in radiological health and radiological safety the maximum permissible exposure value has made possible much of the rapid adoption of various radiological techniques, uses of radioisotopes, and forays into the field of nuclear energy."

Furthermore, Dr. Sachs concluded, one of the major values of such lists of threshold limits is the fact that they are revised annually, and new substances are added as they come forth.

Methods of establishing threshold limits were discussed by Dr. James H. Sterner, Eastman Kodak Co., and the engineering and chemical applications of such standards were presented by Dr. Allen D. Brandt of Bethlehem Steel Co. Prepared discussions of all three papers were heard.

• **MEDICAL.**—The industrial nurses devoted Tuesday afternoon to the topic of how to motivate good work attendance. Meanwhile the IMA, having spent all morning at clinical teaching sessions at the University of Buffalo School of Medicine, opened its regular session that afternoon with the Sappington Memorial Lecture, delivered on the subject of administrative medicine by Dr. E. D. Barnett of Columbia University Medical School and followed by a panel discussion on industrial pulmonary diseases. It continued its session in the evening at the Statler Hotel discussing situations in human relations.

• **AIR POLLUTION.**—Industry's part in combatting the complex problems of air pollution should be brought before the public in order to stop the unjust blame placed on industry for a condition for which it is not entirely responsible, H. G. Mangelsdorf, director and general manager of manufacturing for the Esso Standard Oil Company, New York, told a Tuesday morning meeting of AIHA.

Citing Los Angeles as an example where oil refineries were alleged to be primary contributors to the famous smog and have spent $25 million on control equipment, in addition to $2.5 million on research covering the various phases of the overall problem, "the smog still persists," Mr. Mangelsdorf said. "Because the newspapers failed to publish the industry's part in combatting the problem, the public blamed the oil refineries for the smog."

Mr. Mangelsdorf stressed the need for industries to undertake a vigorous public relations program, not to shift the blame but to show what it is doing.

(*Continued on page* 156)

# STOP *using water!*

Eliminate all water problems with UNICON by KRAMER. Any size compressor, regardless of tonnage, can be air-cooled with UNICON.

KRAMER **UNICON**

Stands, hoods, and wind deflectors are available for simplified outside mounting

You need nothing else!

WRITE FOR BULLETIN U-51AC

KRAMER TRENTON CO. • Trenton 5, N.J.

## INDUSTRIAL HEALTH CONFERENCE

(*Continued from page* 154)

Analysis of hundreds of air samples at Los Angeles and Detroit show that in neither city is carbon monoxide from automobiles a health problem for motorists, pedestrians or the general population. To make such a survey, General Motors Research Laboratories sent mobile "test stations" cruising through streets of both communities. They traveled in light, heavy and dense traffic and covered downtown and residential areas. This was reported on Wednesday to AIHA by three members of GM Research Laboratories' Industrial Hygiene department—Vincent J. Castrop, John F. Stephens and Frank A. Patty.

Their test stations were standard automobiles outfitted with sensitive instruments to detect varying amounts of carbon monoxide in the air. Intake tubes of the instruments were arranged to register exposure a motorist would experience in a moving car and to simulate the breathing zone heights of pedestrians at the curb. Other tests were made at fixed locations 150 feet above downtown streets. These were to find out whether carbon monoxide polluted air above cities. At this level the colorless, odorless gas averaged much less than at street levels.

• **NOISE.**—Early Wednesday afternoon a joint meeting of doctors and nurses took place where hearing standards and audiometry in industry were discussed in three papers. Meanwhile AIHA held one of its concurrent sessions on the subject of industrial noise where five papers treated principles, measuring techniques, control methods, and ear protection devices.

• **ENGINEERING.**—Papers at engineering sessions of AIHA covered air sampling devices and techniques, dust collectors, air pollution control, lighting and ventilating requirements. One of the papers outlined resistance characteristics of flexible exhaust hose from a study by Leslie Silverman, E. W. Connors, and M. W. First of the Harvard School of Public Health. Other concurrent sessions of this group heard papers on toxicology, radiation, and chemical problems in industrial hygiene.

• **OFFICERS.**—Nathan Van Hendricks, head of the industrial hygiene section of the medical research division, Esso Research and Engineering Co., Linden, N. J., became the new President of AIHA. Other officers elected by this group were: President-elect, L. V. Cralley; treasurer, J. F. Treon; secretary, N. Nelson (second year of three-year term); directors, G. H. Collings, M. Eisenbud, and E. C. Hyatt. George D. Clayton was appointed executive secretary to succeed Henry F. Smyth, Jr.

Kiefer Davis, M.D., medical director of the Phillips Petroleum Co., Bartlesville, Okla., became the new president of the Industrial Medical Association, succeeding Robert C. Page, M.D., of New York.

Ralph R. Sullivan, M.D., of the Oregon State Board of Health became the new chairman of the American Conference of Governmental Industrial Hygienists.

Sarah P. Wagner, R.N., of the Standard Oil Company (New Jersey), New York, started her second term in office when she was re-elected president of the American Association of Industrial Nurses.

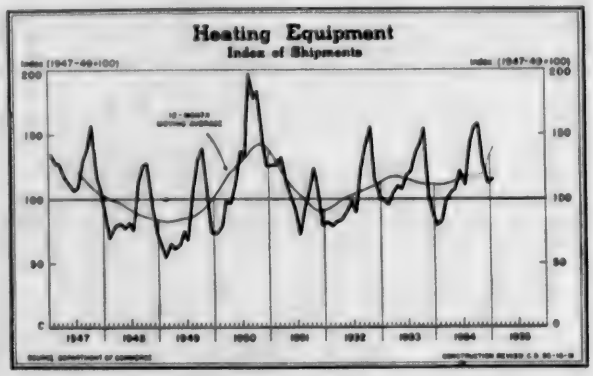
Howard E. DeCamp, D.D.S., of the Corning Glass Works, Corning, N. Y., became the new president of the American Association of Industrial Dentists, succeeding Grant U. MacKenzie, D.D.S., of the Ford Motor Co.

• **AWARD.**—James H. Sterner, M.D., medical director of the Eastman Kodak Co., Rochester, N. Y., received the Donald E. Cummings Award, an honor bestowed annually by the American Industrial Hygiene Association. After receiving the award, Dr. Sterner delivered the Cummings Memorial Lecture to members and guests at the annual banquet of the Association.

## BUSINESS ACTIVITY INDEX

**in heating and plumbing field developed by Department of Commerce. Based on 1947-49 = 100.**

The Department of Commerce has introduced a new series of construction materials output indexes, covering 10 groups of construction materials. Monthly indexes are now available for eight groups and quarterly indexes for two. The eight monthly series cover lumber, millwork, paint and varnish, cement, asphalt products, heating (see chart), iron and steel products and clay products. The two quarterly indexes are on gypsum and plumbing fixtures.




The monthly heating equipment index is computed from data on shipments of cast iron radiators, warm air furnaces, gas water heaters, residential oil burners, and floor and wall furnaces. The quarterly plumbing fixture index is calculated from production on bathtubs, kitchen sinks, water closet bowls, flush tanks, and lavatories.

The chart is a plot of the monthly heating index; the table which follows covers the quarterly index on plumbing fixtures.

**PLUMBING FIXTURE INDEX**
1947-49 monthly average = 100

| Year | 1st Quarter | 2nd Quarter | 3rd Quarter | 4th Quarter |
|---|---|---|---|---|
| 1947 | 93.1 | 94.1 | 87.0 | 103.8 |
| 1948 | 109.7 | 106.9 | 107.1 | 125.4 |
| 1949 | 101.9 | 80.5 | 85.8 | 105.4 |
| 1950 | 116.0 | 119.7 | 129.4 | 135.8 |
| 1951 | 138.1 | 132.7 | 107.0 | 101.3 |
| 1952 | 92.0 | 89.8 | 92.8 | 104.2 |
| 1953 | 106.3 | 106.0 | 92.3 | 99.3 |
| 1954 | 103.3 | 101.0 | 101.3 | 123.1 |

The new indexes appear in and the data presented here are from the April issue of the Department's new *Construction Review*, a monthly publication which began in January.

(*More news on page* 166)

# Ad-Digest SERVICE

**Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.**

**NOTE: While every attempt is made to list all advertisements, those which are received after the published closing date may not appear. The Index of Advertisers lists all the advertisements in this issue.**

**PROCESSING TEMPERATURE CONTROL.** Back cover. A variety of heating, cooling, ventilating, and humidity control problems involved in the mass production program for anti-polio vaccine were handled by this manufacturer of temperature controls. In one incubation room, the company's thermostats regulate valves on steam and chilled water coils of the fan unit to maintain a uniform temperature of 98 deg F. Engineering advice available. .....Item 201

**CENTRIFUGAL PUMPS.** Page 61. These general purpose centrifugal pumps for hot and cold water are made with heads to 201 ft and capacities 400 gpm. The pumps can be flange-mounted, or vertical or horizontal close-coupled. Their motors are 1750 and 3500 rpm, 1 and 3 phase. Pump bulletin and literature available. ..... Item 202

**SINGLE RETORT STOKERS.** Page 11. Two steam-engine-driven, single retort stokers installed in 1927 at a bronze company's boiler plant are still giving efficient service. The company's latest type single retort stokers are individually motor driven, and have adjustable feed controls that provide many rates of coal feed and are regulated either manually or automatically. .....Item 203

**HEATING, COOLING, AND PUMPING.** Page 27. Equipment for water heating systems, air conditioning, and refrigeration installations is made by a single manufacturer. The company manufactures booster and universal pumps, centrifugal pumps, evaporators, condensers, and heat exchangers for steam-to-water and water-to-water. Write for catalogs on each category of equipment .....Item 204

**HOTEL AIR CONDITIONING.** Page 11. This company's fans, air conditioning cabinets, and pumps were installed in a 450-room hotel. The fans supply the needed ventilation to the hotel's public rooms and service areas; the air conditioning cabinets provide the conditioned air for these areas, and the pumps move large quantities of chilled and hot water to the air conditioning system and power plant..Item 205

**REGULATOR AND VALVE.** Page 147. The use of the right type regulator and proper size control valve will insure better temperature control for water heaters or heat exchangers. This company manufactures air or water-operated temperature regulators for ranges from 50 to 250 deg F, or 150 to 350 deg. Simple self-operating regulators for air-operated controls are also available. Write for bulletin.....Item 206

**ROOF VENTILATORS.** Page 61. These aluminum roof ventilators are available in two models. The low silhouette model has backwardly inclined, non-overloading, centrifugal fan wheels and is made in a wide range of capacities. The other model is designed for low parapet buildings and is available in fan wheel sizes from 24 to 48 in. Book with performance data available. .....Item 207

**CAST IRON BOILER.** Page 68. This cast iron boiler has been designed specifically for horizontal rotary oil burners. The boiler, for burners using heavy oils, has a large firebox volume, a high base, a steel front plate for installing the rotary burners, and an enameled steel jacket lined with fiberglass. Write for engineering data. .....Item 208

**SCHOOL TEMPERATURE CONTROL.** Page 13. Automatic temperature control for the heating and ventilating system, hot water generator, and shower bath in a modern school is provided by one company's control system. The company makes a full line of thermostatic controls for heating, air conditioning, hot water generators, and all types of shower baths. .....Item 209

**PISTON-RING EXPANSION JOINT.** Page 51. Piping engineers are asked to check twelve design points of these piston-ring expansion joints. The body of the joint is cast semi-steel in the 125 and 250-lb. series, and fabricated steel in the 150, 300, and 600-lb. series. Write for bulletin.....Item 210

**AIR DIFFUSERS.** Page 26. These air diffusers are custom made with diffusing vanes to provide unlimited air patterns without blank-offs. The company's local representative will assist in selecting the proper size and air patterns to meet particular job requirements. In addition, the company's engineering staff and laboratory resources are available.....Item 211

**COPPER WATER TUBE.** Page 74. Copper water tube that comes in lengths of 60 to 100 ft. for radiant heating systems requires fewer fittings. The fittings that are required are made with solder joint fittings. Write for radiant heating booklet. .....Item 212

**POWER ROOF EXHAUSTERS.** Page 52. Sixty direct-drive power exhausters were chosen to ventilate old street barns that were converted into bus garages. The design of the exhausters includes a low silhouette, low noise levels, and availability in special metals. The direct drive units are available from 120 to 11,000 cfm, belt drive units from 2500 to 85,000 cfm, developing static pressures to 4 in. Information available. .....Item 213

**WATER COOLING TOWERS.** Page 17. Packaged water cooling towers, in models for every service from 2 to 60 tons, have no projecting parts and all their mechanical equipment encased and protected. For indoor installations or for unusual location limitations outdoors, the manufacturer also makes a galvanized counterflow tower in five sizes with capacities from 3 to 15 tons. .....Item 214

**LINE OF CENTRIFUGAL PUMPS.** Page 17. This line of centrifugal pumps for air conditioning service includes a full range of sizes from 1/3 to 3 hp, motor-mounted or belt-driven models, with two casing sizes, a bronze impeller, removable bronze wearing rings, a rotary seal, and a corrosion resistant shaft. The pumps are available with capacities to 90 gpm and with heads to 135 ft. Write for centrifugal pump bulletin. .....Item 215

**BUTT-WELDED LINE PIPE.** Page 71. Butt-welded line pipe for air, oil, gas, and water line applications is made by a firm with over 80 years experience in making tubular products. The pipe is uniform in metallic structure, ductility, strength, corrosion resistance, surface finish, and wall thickness. It is available in sizes from ¼ to 4 in. Information available .....Item 216

**PACKAGED STEAM GENERATORS.** Page 61. The careful sizing and matching of the burner capacities, heating surface, steam space, and evaporating surface of these packaged steam generators eliminates the danger of waste due to excessive stack temperatures. The generators burn oil or gas, or both, and are available in 13 sizes from 20 to 600 boiler horsepower and pressures to 250 psi, or for hot water. Write for catalog containing details.....Item 217

**AIR DUCT FASTENER.** Page 164. More than 2 miles of air conditioning ducts were installed in a department store by using a powder-actuated fastener to set anchoring studs at the rate of better than one per minute. The fastener was also used to hang 13 miles of sprinkler piping and anchor 43 miles of electric conduit. Write for details. .....Item 218

**PROPELLER FANS.** Page 73. A complete stock of propeller fans is as near as this company's local distributor. Included in the company's lines are sizes, models, and capacities to cover needs from small stores to large industrial plants. The fans have sleeve bearings, flexible steel arm motor mountings, streamlined air inlets, and aluminum blades. Literature available on the fans and other equipment..... Item 219

**CONTROL PANEL CABINETS.** Page 174. Factory-assembled panel board cabinets for gas, oil, combination fuel, or stoker installations group primary burner controls, flame safeguards, gages, fuses, and circuit breakers in one standard cabinet 24 in. square and 8 in. deep. The cabinets are also available in special sizes to fill particular needs. Information available. .....Item 220

**Circle numbers corresponding to the advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.**

**PLEASE SEND US MORE INFORMATION**

**Circle below Item numbers on which you wish further information.**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 |
| 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 |
| 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 |
| 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 |
| 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 |
| 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 |
| 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 |
| 299 | | | | | | | | | | | | | |

**PLEASE PRINT** June AD-55

This service available only to U. S. and Canadian readers

**Name**..... **Title**.....

**Firm** .....

**Nature of Firm's Business**.....

**Street** .....

**City**..... **Zone**..... **State**.....

This card is void after Sept. 1, 1955

# Ad-Digest SERVICE

**ACID RESISTING DRAIN PIPE.** Page 12. This drain pipe is made of high silicon iron alloy, which has a very high resistance to corrosion, abrasion, and erosion. The pipe is installed by ordinary plumbing methods and can be counted on, in most cases, to outlast the building. Bulletin available listing details and standard fittings. .....Item 231

**PACKAGED AIR CONDITIONERS.** Page 44. A 15-ton and two 10-ton packaged air conditioners were installed on three floors of a remodeled 23-year old office building. The units take up a minimum of floor space, are completely enclosed, and distribute conditioned air to ducts sealed in the hung ceiling of the building. The units are available in 3, 5, 7½, 10, and 15-ton capacities, which can be used singly or multiple. Write for architectural data. .....Item 232

**HEATING AND VENTILATING UNITS.** Page 168. Compact, versatile units can be horizontally or vertically suspended, or floor-mounted. Choice of coil units, discharge patterns, filter sections, manual or automatic damper controls, and steam or hot water circulation. Ratings from 80,000 to 1,240,000 Btu per hr and 1500 to 11,500 cfm. Folders available. .....Item 233

**SEAMLESS DRAWN COPPER TUBES.** Page 63. Made up to 36 in. ID, in long lengths, copper tubes are light, cannot rust, and smaller sizes can be bent right on the job. Smooth interiors often result in lower pumping costs. Copper piping can be taken down, moved, or have new connections cut in rapidly with solder-type fittings. .....Item 234

**LIQUID CHILLERS.** Page 32. The straight full-size tubes of these direct expansion type liquid chillers have no curves, no bends and no welds. They are made in 1 to five-ton capacities with over 700 baffle and shell combinations available. Individual tubes can be replaced if rupture is ever caused through system control failure. Catalog available. .....Item 235

**HIGH VELOCITY SYSTEMS.** Page 78. High velocity ducts installed through open web joists enabled architects and engineers to save nearly two feet in a one story building. The high velocity systems can be used with smaller than conventional ducts, can be installed to open web joists, require no coils, and can use round, square, and straight line diffusers. For data on high velocity units write on business letterhead for selection manual .....Item 236

**SPECIALIZED SERVICE.** Page 60. Specialized service in planning commercial and industrial air conditioning is offered by this company. The service includes a complete range of modern air conditioning systems, engineering assistance from specialists, and local service from a nation-wide network of trained personnel and facilities. Write for complete information. .....Item 237

**COOLER USES NO FLOOR SPACE.** Page 183. An air conditioning unit for remote installations on new or old construction requires no floor space and can be used with Freon or with hot and cold water. The unit can be installed in vestibules, overhead entrance ways, plenums, closets, or hallways with or without false or furred ceilings. It provides horizontal discharge to one or several adjacent rooms. The manufacturer will send bulletin and specifications .....Item 238

**EXHAUST FANS.** Page 173. Among the various types of exhaust fans made by this company, is one stack exhaust fan that can be used to convert all types of roof ventilators into exhaust or air supply units. The company also manufactures a remote-drive stack exhaust fan that is designed to handle corrosives or high temperature air, or both. Exhaust fan catalog is available. .....Item 239

**HOSPITAL STEAM SUPPLY.** Page 45. The steam requirements of a 251-bed hospital, which has 500 rooms, are supplied by two gas-fired boilers with a combined capacity of 41,000 lb. of steam per hour. The boilers provide the steam needed for heating, hot water, restaurant, laundry, and sterilizing requirements. Boilers such as these are available in standard sizes for loads to 40,000 lb. of steam per hour at pressures to 225 psi. Write for bulletin with illustrated description of the boilers. .....Item 240

**PACKLESS DIAPHRAGM VALVES.** Page 46. Packless diaphragm valves have been operating for almost two years without maintenance on the circulating water lines to condensers, and on the priming and instrumentation systems of a 250,000-kw steam station. Corrosive elements in the water do no attack the working parts of the valves because the sealed bonnet of the valve keeps the working parts out of contact with line fluid. The valves' diaphragm seals the bonnet only and is not required to do the seating. Folder available. .....Item 241

**VENTILATING A BUS TERMINAL.** Page 66-67. In addition to ventilating interior roadways, a bus terminal that serves 130,000 commuters a day, uses one company's equipment to individually air condition its nearly 90 stores. Exhaust fumes and gases from the basement bus-loading level are exhausted at a rate of 150,000 cfm by ventilating fans with 18-ft diameters. Assistance on air conditioning and ventilating is offered. .....Item 242

**PITOT TUBES.** Page 173. These pitot tubes are now graduated in inches on both sides to simplify their centering in the duct and to provide accurate traversing. They are made in a range of sizes from 12 to 60-in. lengths, and P-styles are available with integral ⅛ or ¼-in. pipe thread mounting glands. They are also available with split flange mountings. Made of stainless steel throughout, they can be used for temperatures to 800 deg F. Write for pitot tube bulletin. .....Item 243

**CENTRIFUGAL CIRCULATING PUMPS.** Page 4. Centrifugal circulating pumps from ¼-hp up are suitable for cooling tower or chilled water service in central air conditioning systems. In one installation a 20-hp cradle-mounted pump on cold water circulation service delivers 360 gpm at a 35-ft head. Information on pumps for air conditioning service is offered. .....Item 234

**MULTI-ZONE AIR CONDITIONING.** Page 66. A single unit can replace several by providing simultaneous air conditioning of separate rooms or zones at desired temperatures. The units are advantageous where the problem of fluctuating cooling and heating loads exists. The units are made in capacities from 2500 to 24,000 cfm. Bulletin with complete information is available. .....Item 235

**FAN COOLERS.** Page 155. Eliminate water problems by using fan coolers for any size compressor, regardless of tonnage. Stands, hoods, and wind deflectors are available for simplified outside mounting. Bulletin available. .....Item 236

**RESTAURANT WATER HEATER.** Page 86. A busy Times Square restaurant, which serves from 600 to 700 meals per hour, uses a self-contained, tankless volume water heater to deliver 120 to 130-deg sanitary hot water during 15 hours of continuous hot water demand. The water heaters are available in oil or gas-fired models with capacities of 250,000 to 1,650,000 Btu per hr and with hot water deliveries from 300 to 3,000 gph. Information available. .....Item 237

**INSULATED PIPING SYSTEMS.** Page 63. Early planning of prefabricated insulated piping systems for central heating or air conditioning systems is offered by one company with 45 years experience in the insulated piping field. Custom engineering and the prefabrication of the company's units offer efficient installation. Illustrated piping catalog available. .....Item 238

**AIR CONDITIONING LINE.** Page 28. Window air conditioners, packaged units from 2 to 20 tons, condensing units to 100 tons using F-12 or F-22, multi-zone units serving 2 to 8 zones, and packaged liquid chillers from 7½ to 100 tons are all available from this company's line of air conditioning equipment. Write for information on how to obtain a direct factory franchise. .....Item 239

**DUCT INSULATING BOOKLET.** Page 34. The thermal and acoustical treatment of ducts for air conditioning jobs is discussed in a how-to-do-it booklet prepared by a manufacturer of thermal duct insulation and acoustical duct linings. The booklet is being used by some manufacturers of air conditioning units as a dealer training piece. Write for free copy of the insulation booklet. .....Item 240

**BRINE CHILLER.** Page 141. A brine storage chiller was centrally installed by one company in the basement of a research laboratory. The refrigeration system is the closed-circuit type. The chiller was factory-assembled in the 750-gal brine storage tank, and it circulates the brine at -15 to -18 deg F, with Freon 22 used as the cooling medium. Information available. .....Item 241

**BLOWER UNIT HEATERS.** Page 21-25. A re-designed line of blower unit heaters is offered by one company in 17 different sizes and in 170 ratings from 125,000 to 1,-500,000 Btu per hr, with rates of 1450 to 29,000 cfm. The heaters can be used with or without ducts, and with a by-pass damper, a filter section, and mixing dampers. Bulletin available. .....Item 242

**HIGH PRESSURE AIR DIFFUSERS.** Page 37. High pressure air diffusers designed to handle air at branch duct velocities up to 3000 ft per min permit the use of smaller ducts, thus reducing space requirements. Their outlets are equipped with dampers and sound traps to eliminate noise. Write on letterhead for air diffuser text book. .....Item 243

**CONDENSERS AND CONDITIONERS.** Page 9. A line of refrigeration and air conditioning condensing units, in sizes up to 75 hp, and packaged air conditioners in various models up to 20 hp, was planned at the company's beginning to give dependable performance. The condensing units are for commercial and industrial applications; the air conditioners are for residential or business installations. The company also makes compressor units, up to 75 hp, for use with evaporative condensers. .....Item 244

**PRACTICAL PIPING LAYOUTS.** Page 47. A plan of piping connections is offered by this valve manufacturer for space heating with hot water discharge from refrigeration condensers. A chart of the valves recommended for the layout is also shown. A description and an enlarged diagram of the layout with additional detailed information is offered by the company. .Item 245

Postage Will be paid by Addressee

No Postage Stamp Necessary If Mailed in the U.S.

**BUSINESS REPLY CARD**

FIRST CLASS PERMIT NO. 36, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

**AIR CONDITIONING, HEATING AND VENTILATING**

**93 WORTH STREET**

**NEW YORK 13, N. Y.**

AD-DIGEST SERVICE

**TWO GAS-FIRED BOILERS.** Page 64. Two gas-fired boilers with 20-gage steel jackets are being made by one manufacturer for large homes, apartments, schools, and office and commercial buildings. The 47½ inch high boiler is available for water or steam from 4 to 11 sections with inputs from 180,000 to 600,000 Btu per hr. The 63-in. high boiler is available for water or steam from 6 to 41 sections with inputs from 650,000 to 3,200,000 Btu per hr. Detailed descriptions of the boilers are available. .....Item 246

**WATERLESS AIR CONDITIONER.** Page 167. A waterless air conditioner can cool an entire house using existing ducts and standard electrical connections. It is available in a 2-hp floor model that requires no ducts and in 2 and 3-hp units for attic, roof, or outside installations. The latter units can also be used for slab floor or basement tie-in. Write for complete details. .....Item 247

**INVERTED BUCKET TRAPS.** Inside front cover. Dozens of one company's traps are used in a greenhouse to drain heating coils operating at 2 to 10-lb pressure with a 10-in. vacuum return. The traps are factory-tested at 500-lb water pressure. They receive the same design, material, and workmanship used in traps for power plant service at 900-lb pressure and 900-deg temperature. Two booklets with facts on traps are available. .....Item 248

**SAFETY VALVES AND CONTROLS.** Page 178. This company's line of hot water heating safety valves and controls includes ASME rated pressure safety valves, feed water pressure regulators, and dual controls. Its steam heating boiler water level controls include boiler water feeders and low water cut-offs. Its protective devices for hot water supply systems include fully automatic temperaure and pressure relief valves, and water tempering valves. The valves and controls are made in a variety of sizes, capacities, and types. .....Item 249

**WALL AND ROOF EXHAUSTERS.** Page 44. This producer of commercial wall and roof exhausters offers low contour roof exhausters that blend with the architectural design of the building. Its wall exhausters have a button design that spots ventilation control. The roof exhausters have their power assembly nested into the base of the unit to give a high point of discharge near the top of the unit and still retain a low contour. Write for name of company's distributor. .....Item 250

**PUMP ENGINEERING HELP.** Page 143. This company's representative or distributor will help you get the simplest and most effective possible layout. A complete range of types and sizes of air conditioning pumps is carried in stock by regional warehouses and authorized distributors throughout the country.....Item 251

**GALVANIZED SHEETS.** Page 19. Galvanized roofing and siding sheets are manufactured by one firm in a variety of types which include steel sheets with a safety drain, V-crimp sheets, and corrugated steel. The V-crimp sheets are made with 2, 3, and 5 V-crimps, and in gages 26, 28, and 29, with a covering width of 24 in. .....Item 252

**SILENT SALESMAN.** Page 49. One air conditioner is dubbed by its manufacturer as a silent salesman when installed, for example in a retail store. The air conditioner has 4-way directional louvers and a large vertical cooling coil. Its pumped-down control system guarantees instant cooling coil response and reduces system-operating pressures. The air conditioner is available in five models.....Item 253

**STAINLESS STEEL FITTINGS.** Page 23. Stainless steel welding fittings are the answer to many piping problems, such as corrosive conditions. This line of stainless steel welding fittings and flanges includes A181 Types 304, 304L, 347, and 316, thin and heavy wall. The fittings and flanges meet U. S. piping code specifications. .....Item 254

**BOILER SELECTION.** Page 75. According to one manufacturer the selection of a boiler is more a question of where it is bought than what boiler is chosen. This same manufacturer makes boilers with a guaranteed thermal efficiency of 80%, in 16 sizes from 10 to 600 hp, with 15 to 200-lb water pressures, and oil, gas, or oil-gas combinations. Write for details and name of company representative. .....Item 255

**COMPRESSOR STAYS YOUNG.** Pages 14-15. Compressors made with capacities of 10 to 50 tons and in duplex models to 100 tons are engineered by the manufacturer to stay young. They feature multi-step capacity control, thorough cleaning of oil, a reversible oil pump, cadmium-plated valves, valve silencers, a spring-loaded safety head, and aluminum pistons and connecting rods. Information available. .....Item 256

**FAN BULLETINS.** Page 57. A new series of centrifugal fans both forward curve and non-overloading are described in four bulletins. The bulletins with complete engineering data and capacity tables are now ready for distribution. Write for copies.....Item 257

**COPPER TUBE.** Page 85. By making tubing, and only tubing, in one of the country's largest completely integrated mills, this company's production experts are able to direct all their know-how toward making better copper tubing. Everyone in the company from the top on down, stands ready to offer their service. The tubing is sold to wholesalers only. .....Item 258

**ZINC-COATED SHEETS.** Pages 22-23. These galvanized sheets are made from a soft, ductile base metal with a tight zinc coating that will take anything the base metal will. The manufacturer of the sheets also makes galvanized furnace pipe, snap lock or closed seam perimeter heating or air conditioning pipe, and accessories. .....Item 259

**VENTILATING LINE.** Page 41. Power roof ventilators, blowers, furnace fans, unit heaters, propeller fans, universal blowers, air conditioning units, and ventilating sets are included in this company's line of products. Bulletins on each are available. .....Item 260

**COOLING TOWERS AND CONDENSERS.** Page 2. Cooling towers, in 2 to 130-ton capacities, and water-cooled condensers, in 1/3 to 25-ton capacities, are matched to work with each other. The wetted deck surfaces of the towers carry a 10-year guarantee against rotting or fungus attack. The condenser's tubes can be cleaned by a mechanical cleaning tool to restore heat transfer efficiency. Write for detail specifications on towers and condensers. .....Item 261

**AUTOMATIC DRAFT CONTROL.** Page 167. A draft adjuster, which controls the draft automatically, can be installed and adjusted on the top, side, under the breeching, or at the base of the chimney. Sizes are made to meet every job. Bulletin available. .....Item 262

**PUMPS FOR EVERY NEED.** Page 69. The line of pumps manufactured by one company for boiler and other services, includes turbine pumps, condensate pumps, vertical pumps, and a duplex pump. The duplex pump consists of one cast iron receiver, two pumps, two motors, and complete float mechanisms. Bulletin with data on single and duplex pumps is available. .....Item 263

**DUCT FANS.** Page 1. These duct fans exhaust fumes at top efficiency by avoiding a directional change in the air stream. Fan motor stays clean, cool and accessible. Fumes are by-passed, or bifurcated, from the exhaust stream. Available in sizes from 12 to 48 inches in diameter. Bulletin available. .....Item 264

**STEAM OR HOT WATER BOILERS.** Page 145. Forced-draft, four-pass construction boilers are made for heating or processing in sizes from 15 to 300 hp and 15 to 250 psi. Five square feet of heating surface per boiler hp produce 80% operating efficiency when fired with oil. The burner design makes it possible to interchange gas and oil firing in 10 seconds. Catalog available. .....Item 265

**GLASS FIBER DUCT INSULATION.** Page 88. Aluminum-foil-faced duct insulation was installed on the new air conditioning system at the Atlantic City Convention Hall. The job involved approximately 18,-000 sq ft of duct insulation. The insulation is pliable and will conform to irregular contours. The glass fibers of the insulation will not burn or absorb moisture. Installation instructions available. .....Item 266

**COPPER WATER TUBE.** Page 127. Radiant panel heating fits perfectly into the growing trend to one-story school construction, and the ideal material for panel heating is copper. Use of this copper water tube means easy bending and handling; its long lengths require fewer fittings, and the solder fittings used eliminate the need for welding, wrench work, and thread cutting. Technical advisory service available. .....Item 267

**UNIT HEATERS.** Page 167. Oil-fired unit heaters are manufactured by this company with outputs from 112,000 to 280,000 Btu per hr. The company has representatives in major cities. Twelve-page catalog available. .....Item 268

**CENTRIFUGAL PUMP.** Page 173. Designed for air conditioning systems, this pump is equipped with a reversible ceramic floating seat and carbon washer combination, held by a stainless steel spring, in addition to a rotary-type mechanical shaft seal. This shaft is solid stainless steel, preventing rust or corrosion even when cooling water is chemically polluted. Bulletin available. .....Item 269

**WELDED FIREBOX BOILER.** Page 89. Leakproof dependable performance is offered by an all-welded firebox boiler. The precision-formed, fusion-welded boiler remains tight under all operating conditions. Twelve sizes are made to cover service requirements from 25 to 304 hp. Bulletin available. .....Item 270

**MOISTURE CONTROL.** Page 168. This air conditioning method dries air directly and measurably, using a moisture-absorbing liquid spray. It makes humidity control a separate function from lowering or raising temperatures and gives you precise control with thermostats alone. Bulletins available. .....Item 271

**Use this digest to locate and refer to advertisements appearing in this issue of AIR CONDITIONING, HEATING AND VENTILATING, then fill out and mail the prepaid postcard to request further information.**

**Circle numbers corresponding to the advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.**

**PLEASE SEND US MORE INFORMATION**

**Circle below item numbers on which you wish further information.**

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 201 | 202 | 203 | 204 | 205 | 206 | 207 | 208 | 209 | 210 | 211 | 212 | 213 | 214 |
| 215 | 216 | 217 | 218 | 219 | 220 | 221 | 222 | 223 | 224 | 225 | 226 | 227 | 228 |
| 229 | 230 | 231 | 232 | 233 | 234 | 235 | 236 | 237 | 238 | 239 | 240 | 241 | 242 |
| 243 | 244 | 245 | 246 | 247 | 248 | 249 | 250 | 251 | 252 | 253 | 254 | 255 | 256 |
| 257 | 258 | 259 | 260 | 261 | 262 | 263 | 264 | 265 | 266 | 267 | 268 | 269 | 270 |
| 271 | 272 | 273 | 274 | 275 | 276 | 277 | 278 | 279 | 280 | 281 | 282 | 283 | 284 |
| 285 | 286 | 287 | 288 | 289 | 290 | 291 | 292 | 293 | 294 | 295 | 296 | 297 | 298 |
| 299 | | | | | | | | | | | | | |

**PLEASE PRINT** June AD-55

This service available only to U. S. and Canadian readers

**Name**..... **Title**.....

**Firm** .....

**Nature of Firm's Business**.....

**Street** .....

**City**..... **Zone**..... **State**.....

This card is void after Sept. 1, 1955

# Ad-Digest SERVICE

**SUBMERGED TANKS.** Page 163. Tanks and boilers are custom fabricated and lined. Suggestions are offered for fabrication and lining economies. Literature available. ..... Item 272

**GAS UNIT HEATERS.** Page 26. This company's line of gas unit heaters includes a propeller fan-type, a blower-type, a twin-fan model, and console-styled floor models. The company also announces two new duct furnaces for custom engineered heating and air conditioning systems. ..... Item 273

**FANS.** Page 30. An interesting and necessary feature of an electric company's new zinc and cadmium plating line is the compactness of the fan exhaust system. Centrifugal units would have necessitated an expensive modification in the building structure, but the compact in-line design of this company's fans permitted installation right in the ducts on the floor above the plating line. Bulletin available. ..... Item 274

**UNIT AIR CONDITIONERS.** Page 56. Unit air conditioners built in 2, 3, and 7½-hp sizes can be adapted to the layout of stores, restaurants, hotels, offices, factories, and other businesses through the duct work. The air conditioners have insulated condensers, self-cleaning filters, and heavy construction. Distributor territories and bulletin available. ..... Item 275

**MECHANICAL LUNGS.** Page 162. Highly flexible in purpose or position, this backward blade centrifugal fan is designed for use in heating, ventilating, and air conditioning systems, power plant installations, and industrial processes. ..... Item 276

**HEATING SPECIALTIES.** Page 62. Three Chicago suburbs have equipped new schools with this line of valves and traps in steam heating systems. Packless radiator valves and radiator traps went into the heating systems, which involved both direct and indirect radiation. Catalog available. ..... Item 277

**AIR FILTERS.** Page 70. Filters made of nine electro-plated, herringbone-crimp steel screen media in steel finishings are made in nine standard types. They also are made in aluminum, stainless steel, and monel, and are available in all sizes. The sizes range from 1 to 4-in. thick. Catalog available. ..... Item 278

**A-BOMB PROOF BUILDING.** Page 32. The first building in the Washington, D. C., area especially designed and built to withstand an atom-bomb explosion is air conditioned with one manufacturer's equipment. The equipment includes 8 spray-type dehumidifiers with cooling coils, 4 ceiling-type air handling units, 45 floor-type remote air handling units, and 78 heating coils. Information available. ..... Item 279

**DRIVE EQUIPMENT.** Pages 14-15. Control-motor-drive combinations can be ordered from one source of supply. The company offers engineering help in planning the drive combination, complete stocks in authorized distributors and regional offices, and nearly 100 independent service shops which use factory-approved parts and methods. Engineering literature is available on the motors, controls, and drives. ..... Item 280

**SHEET METAL EQUIPMENT.** Page 185. The sheet metal equipment of one manufacturer can be used to perform more operations than anticipated in a fast and easy way. ..... Item 281

**HIGH VELOCITY AIR FILTERS.** Page 165. This filter media has special hemmed edges for strength and safe, easy handling. They have a maximum efficiency of 298 to 510 fpm. Low velocity and grease filters are also made. Catalog available ..... Item 282

**LOW PRESSURE PIPE INSULATION.** Page 42. One-half inch of this moisture-resistant, rot-proof insulation for low pressure steam pipes and hot and cold water lines saves space and offers less surface heating painting. Full data on sizes, factory-applied vapor areas, applications, and thermal efficiency are contained in the manufacturer's new technical bulletin. Send for copy. ..... Item 283

**CONCEALED AIR DIFFUSER.** Page 42. Ceiling air diffusers that are completely concealed in metal pan ceilings have no protruding or exposed outlets to present problems in symmetry or in architectural effects. The complete concealment of both supply and return panels is also possible when cooling only is desired. Literature available. ..... Item 284

**GAS-FIRED DUCT FURNACES.** Page 172. This stainless steel, gas-fired duct furnace is specially built for use with cooling coils or packaged air conditioning. Made in five sizes from 82,000 to 215,000 Btu per hr. inputs, the furnaces has many applications in air conditioning systems, as a concentrated source of heat, as a booster, and for drying, processing, and ventilating. Bulletin available. ..... Item 285

**LIQUID DEPTH GAGES.** Page 184. Remote reading liquid depth gages for tanks 20 in. to 30 ft deep can be installed on tanks above or below the ground and up to ¼ of a mile away. The gage can be used for commercial and industrial liquid storage tanks and for domestic installations with buried tanks. Bulletin available. ..... Item 286

**CABINET UNITS.** Page 54. These cabinet units give positive and quiet distribution of heated air, and, with modest-priced accessories, they also provide introduction, filtering, and distribution of outside air. Made in five models from 120 to 640 EDR, some units heat with hot water, cool with chilled water, and others are made for steam or hot water heating only. Bulletin available. ..... Item 287

**HIGH VELOCITY AIR VALVE.** Page 151. This patented air valve transforms high velocity air to low velocity near the point of room entry. The valve can be installed directly behind the grille at the junction of high velocity trunk ducts with conventional velocity branch ducts to supply several diffusers. The air valve is adjustable through the grille opening. Engineering help on high velocity applications is available. ..... Item 288

**STEEL SALES OFFICES.** Page 48. This manufacturer of steel sheet and tube has 28 district sales offices located throughout the nation. They are staffed with men who know the steel business thoroughly and are qualified to help with steel requirements. You can get quick service whether you write, wire, or phone. ..... Item 289

**PACKAGED LIQUID CHILLER.** Page 149. Consider the six advantages of these packaged liquid chillers for process cooling, refrigeration, or air conditioning. For chilling either water or brine, the units are made in sizes from 7½ to 200 hp. Send for bulletin telling about the specifications, features, and typical applications of the chillers. ..... Item 290

**PORTABLE CONTACT PYROMETER.** Page 162. This portable contact pyrometer will give temperature readings instantly of any surface, metallic or non-metallic, flat, curved, stationary, or revolving. For checking the temperature of steam traps, motors, and bearings, eight standard F-scale ranges are available up to 1200 deg F. Details of the pyrometers are contained in a bulletin. ..... Item 291

**CEILING AIR DIFFUSERS.** Page 163. These ceiling air diffusers provide full dimension heating and air conditioning comfort. They are made in five flush and five extended models, sized for 6 to 14-in. ducts, with a baked-on metallic finish. Write on letterhead for free literature. ..... Item 292

**VACUUM PUMPS.** Page 28. Vacuum pumps are made in single and duplex units with ratings to 20,000 sq ft EDR to remove up to 200% of rated capacities of air that start the heating cycle. The manufacturer also makes vacuum pumps to 100,000 sq ft EDR and condensation pumps to 150,000 sq ft EDR. All the pumps have cast iron receivers. ..... Item 293

**ELECTRONIC AIR CLEANING.** Page 75. A comparison of electronic air cleaning to air filtering was made by a research test in which equal quantities of outdoor air were drawn through two channels. In one channel the air was filtered and then cleaned, and in the other channel the air was cleaned and then filtered. After 21 days of operation, the accumulated dirt was recovered and weighed. Send for facts on electronic air cleaning. ..... Item 294

**BOILER WATER CONTROLS.** Page 37. A combined boiler water heater and low water cutoff control was installed recently on a gas-fired boiler which heats a modern school. Instead of being installed in the gage glass tappings, 1-in. equalizing pipe is used on boilers of this kind which have independent water columns. The controls are available for hand- and automatically-fired steam boilers up to 150 lb pressure. ..... Item 295

**PACKAGED FANS.** Inside back cover. These V-belt fans are ready to run, with fan, motor and drive in one connect assembly. They are made in 14 sizes with wheel diameters from 9¾ to 22½ in., and with capacities to 12,000 cfm. Direct-connected units are also available. A 28-page catalog with information on the units is available. ..... Item 296

**INDUSTRIAL OIL BURNERS.** Page 161. These industrial oil burners have a magnetic valve which is controlled by the oil temperature and will not admit oil to the rotary atomizing cup until it is warm enough to fire properly. Thus the oil burners provide accurate oil metering, fine atomization, quick starts, and no slug of cold oil in the lines. An illustrated 20-page catalog is available describing the automatic burners. ..... Item 297

**FLEXIBLE DUCT CONNECTORS.** Page 170. Available in 25, 50, or 100-ft rolls, this flexible duct connecting material can be measured and cut on the job to fabricate any type of flexible duct connector. It is made in a choice of canvas, asbestos, and Neoprene-coated fiber glass, in 3 or 6 in. widths attached to 24 or 26-gage galvanized steel or 24-gage aluminum. Catalog and specification sheet are available. ..... Item 298

**SEWAGE PUMP.** Page 171. This economical sewage pump with a non-clog impeller is a heavy-duty sewage ejector. The unit is factory assembled and requires only one piping connection for its installation. Bulletin available. ..... Item 299

Postage Will be paid by Addressee

No Postage Stamp Necessary If Mailed in the U. S.

BUSINESS REPLY CARD

FIRST CLASS PERMIT NO. 36, SEC. 34.9, P. L. & R., NEW YORK, N. Y.

AIR CONDITIONING, HEATING AND VENTILATING

93 WORTH STREET

NEW YORK 13, N. Y.

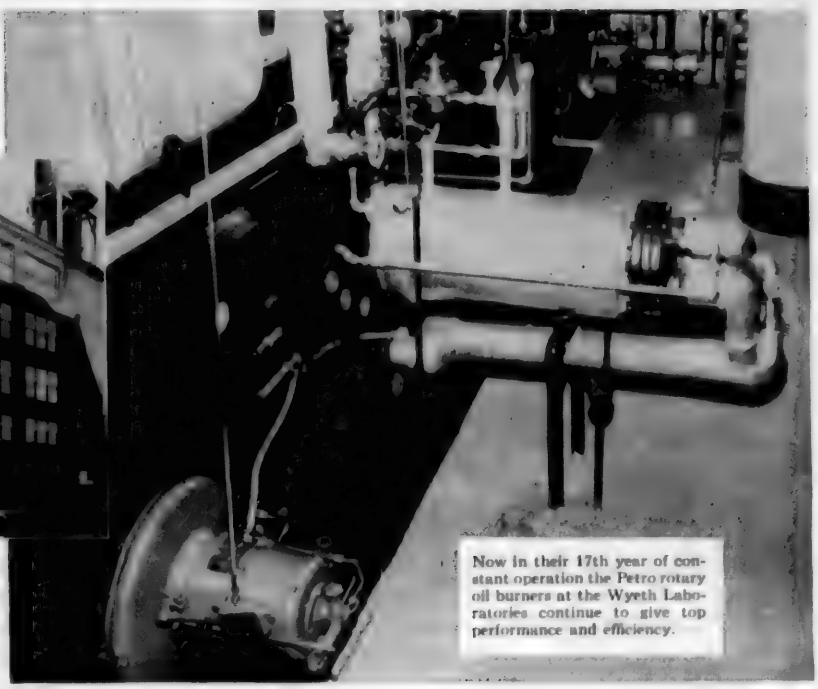
AD-DIGEST SERVICE

## Petro Industrial Oil Burners

# PAID FOR THEMSELVES DURING THE FIRST YEAR

*for the*

**WYETH LABORATORIES, INC.**
**Philadelphia, Pa.**



Now in their 17th year of constant operation the Petro rotary oil burners at the Wyeth Laboratories continue to give top performance and efficiency.

**"Petro oil burners saved us $6,349 on fuel the first year—and in addition we enjoy better heating and more horsepower from our boilers," says E. C. Beeler, Plant Engineer.**

FUEL SAVINGS JUST DON'T HAPPEN—there has to be a reason—and the Petro "Thermal Viscosity System" is the reason Petro equipment owners all over the country save thousands of dollars every year! It's a simple, foolproof fuel preheating system which lowers the viscosity of the low-cost, heat-rich heavy oils and enables users to burn them with complete reliability.

### Here's how it works

To properly fire No. 6 oil, the oil must be *warmed* so that it will thin out and ignite easily and atomize efficiently. To accomplish this vital need Petro burners have a magnetic valve which is controlled by the oil temperature and will not admit oil to the rotary atomizing cup until it is warm enough to fire properly. The oil is circulated through automatic heaters until the proper temperature is reached. Heaters are of ample capacity to supply warm oil for any firing need.

Thus Petro oil burners assure owners (1) accurate metering of oil (2) fine, thorough atomization (3) quick starts, no smoky fires (4) no slug of cold oil in lines to cause faulty starts.

### No manual attention is required

The entire operation is automatic. There are no involved mechanical controls requiring adjustment or maintenance.

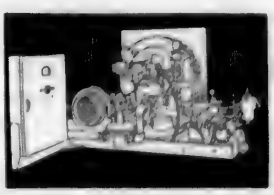
### Saves labor costs—saves fuel costs

Why don't you find out how much Petro industrial oil burners can save for you? They are quickly adaptable to nearly every existing boiler. Send in the coupon for full information.

**OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT**

**PETRO**

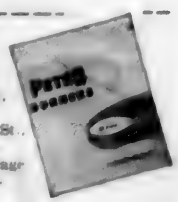
T.M. REG. U.S. PAT. OFF.



**COMPLETE PACKAGED UNIT**

A complete forced draft combustion system with all parts factory assembled and tested. Saves installation time and cost, gives top performance and fuel economy.

**MAIL THIS COUPON FOR FREE CATALOG**



PETRO
3245 West 106th Street,
Cleveland 11, Ohio.

In Canada: 2231 Bloor St., West, Toronto, Ontario.

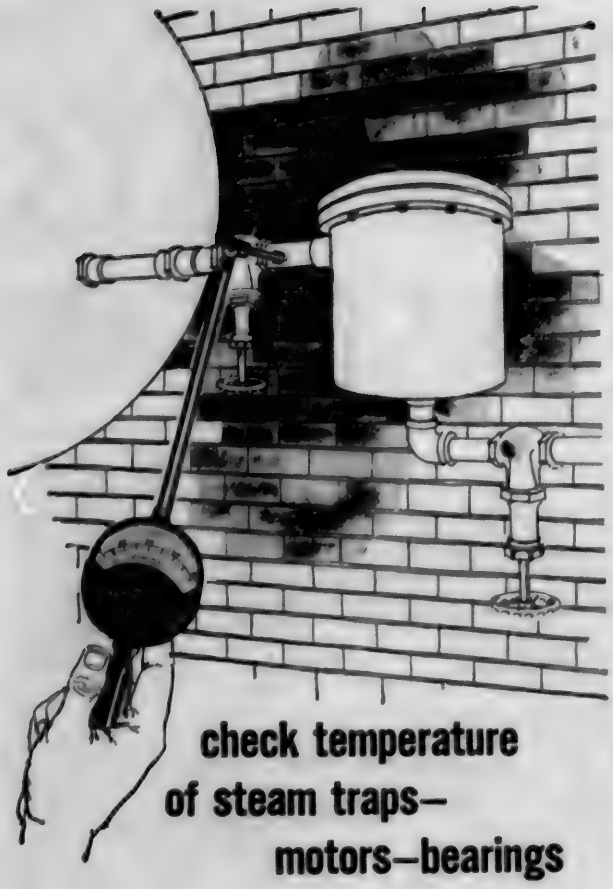
Please send the 20-page illustrated Petro catalog.

Name _____

Company _____

Address _____

City _____ State _____



check temperature of steam traps— motors—bearings

. . . quickly and accurately with the Alnor Pyrocon, the portable contact pyrometer for taking surface temperatures. This handy, portable instrument can be your most useful maintenance and installation tool . . . it provides accurate temperature readings instantly of any surface (metallic or non-metallic), flat, curved, stationary or revolving.

It's a well-balanced instrument mounted in a sturdy case for protection against the usual hazards of on-the-job service. Jeweled movement is also heavy-duty, shock-resistant type that will withstand hard and continuous use . . . performing with laboratory accuracy.

A wide selection of thermocouples and extension arms assures its adaptation to your needs. Eight standard F. scale ranges are available up to 1200°F. Send for complete details contained in Bulletin 4257. Illinois Testing Laboratories, Inc., Rm. 514, 420 N. LaSalle St., Chicago 10, Ill.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

## Thermal Stresses in Building Materials

(*Concluded from page* 144)

to less than about 6000 cu. ft per hr. smoke tends to come out into the room.

Bench tests show that the free-standing fire has a radiation efficiency of about 19% plus a convection efficiency of about 13%, total 32%. This compares with a total of around 23% (all radiation) for an ordinary fire. Bench tests do not show, however, what will happen in an ordinary room in the care of ordinary folk. So Mary Davidson, D. E. Kimber, and R. E. J. Tulett of the B.C.U.R.A. Laboratories at Leatherhead arranged some field tests. Their report (*Journal Inst. Fuel* **27**, *170*, 123) was read before the Institute in April.

Various local bodies, such as women's organizations, were appealed to and 170 volunteers offered to make tests in their houses. Finally a total of 40 were chosen to be as alike as possible, and after a period of 5 winter weeks during which each householder weighed all the coal he put on his fire, and tolerated 2 or 3 visitations for measurement of room temperature etc., two-thirds of them had their fires replaced by one or other of two types of free-standing fire. The tests were then all repeated, the unchanged households acting as controls.

The householders were using their own coal and paying for it, and so one datum of interest is the temperature they kept their own living-rooms at for watching television in the evening. The average of room thermographs was about 60 deg. Actually 58.6 deg on this corresponded with reasonable comfort. The major part of the volume of each room had an *equivalent temperature* in excess of 65 deg. Warmer near the fire, of course. The verdict on the free-standing fire: a 21% saving in fuel and an improved standard of warmth, especially in cold weather, making it 60 to 70% better than an ordinary open fire.

**Canadian Degree Days for April, 1955***

| City | April | | Cumulative | |
|---|---|---|---|---|
| | 1955 | Normal | 1954 | Normal |
| Calgary, Alta. | 861 | 750 | 8188 | 8631 |
| Charlottetown, P. E. I. | 873 | 858 | 7221 | 7727 |
| Crescent Valley, B. C. | 771 | 624 | 7382 | 7328 |
| Edmonton, Alta. | 822 | 780 | 8728 | 9369 |
| Fort William, Ont. | 680 | 888 | 9301 | 9478 |
| Grande Prairie, Alta. | 858 | 822 | 9415 | 9617 |
| Halifax, N. S. | 752 | 768 | 6214 | 6902 |
| London, Ont. | 450 | 642 | 6639 | 6968 |
| Medicine Hat, Alta. | 684 | 606 | 7750 | 8194 |
| Moncton, N. B. | 843 | 798 | 7513 | 8094 |
| Montreal, P. Q. | 619 | 715 | 7737 | 8088 |
| North Bay, Ont. | 609 | 813 | 8728 | 8746 |
| Ottawa, Ont. | 590 | 726 | 8012 | 8364 |
| Penticton, B. C. | 615 | 507 | 6228 | 6073 |
| Porquis Junction, Ont. | 678 | 972 | 10144 | 10586 |
| Prince George, B. C. | 853 | 738 | 8386 | 8506 |
| Quebec City, P. Q. | 786 | 849 | 8488 | 8848 |
| Regina, Sask. | 684 | 816 | 9449 | 10457 |
| St. John, N. B. | 764 | 792 | 7315 | 7576 |
| Saskatoon, Sask. | 756 | 725 | 9620 | 10081 |
| Toronto, Ont. | 441 | 669 | 6121 | 6895 |
| Vancouver, B. C. | 586 | 498 | 5001 | 4977 |
| Victoria, B. C. | 585 | 504 | 4867 | 4569 |
| Windsor, Ont. | 348 | 582 | 5854 | 6454 |
| Winnipeg, Man. | 540 | 822 | 9607 | 10444 |

*These data are supplied through the courtesy of the Meteorological Division Air Service Branch, Department of Transport, Canada.

The Department reports slight revisions in the figures for March as published in last month's issue. Corrected figures are: Edmonton, Alta., 1560; Montreal, P. Q., 1230; Regina, Sask., 1721.

**...HE WOULDN'T INSTALL**

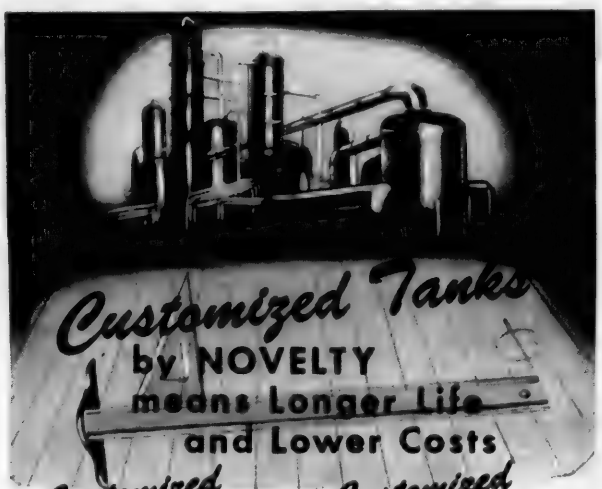
**STANDARD STAMPING'S CEILING AIR DIFFUSERS!**

And how can anyone be really comfortable without the full dimension heating and air conditioning comfort that only Standard Ceiling Air Diffusers provide. Five flush and five extended models, sized for 6" to 14" ducts. Baked on metallic finish. Also dampers, installation rings, and accessories.

**...attach this ad to your letterhead for free literature!**

**STANDARD STAMPING & PERFORATING CO.**

3141 W. 49th Place, Chicago 32, Illinois




*Customized*
**FABRICATION**

Let us assist in the engineering of systems that require tanks—by offering suggestions in fabrication economies. At your disposal is our many years of experience in selecting and processing materials for building tanks of steel, stainless steel, copper, nickel, monel and all clads.

*Customized*
**LINING**

Let our Novelon Lining Department offer their suggestions as a solution to your storage problem. Considerable savings are often possible by specifying a time-tested lining as an alternate to far more expensive steel alloys—with protection against corrosion guaranteed.

***For free literature and information write or phone . . .***

**NOVELTY STEAM BOILER WORKS, INC.**

*Quality Fabricators for 50 Years*

Clare and Kloman Sts. ARROW STEEL TANKS HAMCO Baltimore 30, Maryland

Telephones Baltimore Plaza 2-0425 • New York BAyside 5-6600

**INDUSTRY Breathes Easier with GENERAL mechanical lungs!**

Shown here is a "General" backward blade centrifugal fan. Highly flexible in purpose or position it is designed for use in heating-ventilating and air conditioning systems, power plant installations and industrial processes. Non-overloading, quiet operation are inherent qualities in all General backward blade fans.

BACKWARD BLADE WHEEL AND SPUN INLET.

Greater efficiency, longer life, less maintenance cost are automatically yours in every General Blower product. Over twenty years experience in manufacturing heavy duty air moving equipment for the nation's leading industries is the guarantee of quality behind each blower leaving our plant.

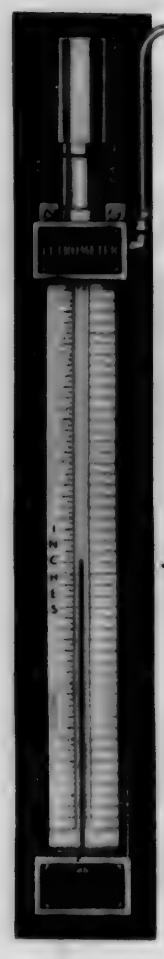
Let General Blower engineering "know how" help you with your next air handling problem. Contact the engineering sales representative in your area or write General Blower Company.

CERTIFIED RATINGS
AUTHORIZED BY A F M

**GENERAL BLOWER COMPANY**

**8601 FERRIS AVENUE**

**MORTON GROVE, ILLINOIS**



# PETROMETER
## REMOTE READING
# LIQUID DEPTH GAUGES

*"Bring Your Liquid Level to Eye Level"*

**THE BEST GAUGE FOR:**

*Commercial and Industrial Fuel Oil Storage Tanks*

*Domestic Installations with Buried Tanks*

*Storage Tanks for other Industrial Liquids—gasoline, solvents, acids, etc.*

**HERE'S WHY:**

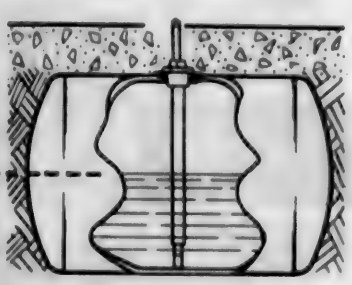
Can be installed on tanks above or below the ground and up to ¼ of a mile away.

No troublesome moving parts—operates on the principle of the U-tube. Simple, dependable and accurate.

Large, easy-to-read vertical scale gives tank contents at a glance. Scales are easily changed for different liquids.

Easy to install—the tank assembly for the gauge can be installed when the tank is empty or when containing liquid. It can also be installed separately to complete the tank work. The gauge can be connected any time later. Only one simple connection to tighten.

**WRITE FOR BULLETIN PH TODAY.**



FOR TANKS 20 INCHES TO 50 FEET DEEP.

**LIQUIDEPTH INDICATORS, INC.**
**43-22 TENTH STREET**
**LONG ISLAND CITY 1, N. Y.**


# COMING EVENTS

**Where listed, names or titles of individuals are those from whom further information is available.**

**POWER ENGINEERS CONVENTION**—73rd annual convention of the National Association of Power Engineers, Inc., at the Hotel Waldorf-Astoria, New York, N. Y. A. F. Thompson, secretary of the Association, 176 W. Adams St., Chicago, Ill. . . . . **JUNE 13-17, 1955.**

**COMBUSTION CONFERENCE**—International Conference on Combustion, sponsored by the American Society of Mechanical Engineers, New York, N. Y. and The Institution of Mechanical Engineers, London, England, in cooperation with the Office of Summer Session of Massachusetts Institute of Technology, to be held in Kresge Auditorium of Technology at MIT, Cambridge, Mass. C. E. Davies, secretary of ASME, 29 W. 39th St., New York, N. Y. . . . . **JUNE 15-17, 1955.**

**TESTING MATERIALS MEETING**—Annual meeting of the American Society for Testing Materials, at the Chalfonte-Haddon Hall, Atlantic City, N. J. Secretary of the Society, 1916 Race St., Philadelphia, Pa. . . . . **JUNE 26-JULY 1, 1955.**

**ASHAE MEETING**—The semi-annual meeting of the American Society of Heating and Air-Conditioning Engineers in San Francisco, Calif. A. V. Hutchinson, executive secretary of the Society, 62 Worth St., New York 13, N. Y. . . . . **JUNE 27-29, 1955.**

**INTERNATIONAL CONGRESS OF REFRIGERATION**—Ninth International Congress of Refrigeration, sponsored by the International Institute of Refrigeration, to be held in the conference rooms of the Sorbonne in Paris, France. General Secretariat of the Congress, International Institute of Refrigeration, 177, Boulevard Malesherbes, Paris, France . . . . . **AUGUST 31-SEPTEMBER 15, 1955.**

**INSTRUMENT SOCIETY CONFERENCE**—Tenth Annual Conference and Exhibit of the Instrument Society of America, to be held at Shrine Exposition Hall and Shrine Auditorium, Los Angeles, Calif. John McCaffery, assistant executive secretary of the Society, 1319 Allegheny Ave., Pittsburgh 33, Pa. . . . . **SEPTEMBER 12-16, 1955.**

**GAMA MEETING**—Annual meeting of the Gas Appliance Manufacturers Association, at the El Mirador, Palm Spirngs, Calif. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York,. N. Y. . . . . **OCTOBER 12-14, 1955.**

**WHOLESALE PLUMBING AND HEATING CONVENTION**—4th annual convention of the American Institute of Wholesale Plumbing and Heating Supply Associations, Inc., to be held at the Hotel Waldorf-Astoria, New York, N. Y. G. T. Underwood, executive secretary of the Institute, 402 Albee Building, 1426 G St., N. W., Washington, D. C. . . . . **SEPTEMBER 17-21, 1955.**

**AGA CONVENTION**—1955 convention of the American Gas Association and the Pacific Coast Gas Association, at the Statler Hotel, Los Angeles, Calif. Secretary of the AGA, 420 Lexington Ave., New York 17, N. Y. . . . . **OCTOBER 17-19, 1955.**

**ASA MEETING**—Annual meeting of the American Standards Association, at the Sheraton Park Hotel, Washington, D.C. Secretary of the Association, 70 E. 45th St., New York 17, N. Y. . . . . **OCTOBER 24-26, 1955.**

**SOLAR ENERGY SYMPOSIUM**—A World Symposium on Applied Solar Energy, sponsored by Stanford Research Institute, Stanford, Calif., to be held at Phoenix, Ariz. Chairman of the Institute, 612 S. Flower St., Room 332, Los Angeles 14, Calif. . . . . **NOVEMBER 2-5, 1955.**

**POWER EXPOSITION**—Chicago Exposition of Power & Mechanical Engineering, at the Coliseum, Chicago, Ill., to be held under the auspices of The American Society of Mechanical Engineers, in conjunction with their 75th Anniversary meeting. E. K. Stevens, manager, International Exposition Co., Inc., 480 Lexington Ave., New York, N. Y. . . . . **NOVEMBER 14-18, 1955.**

**ASRE WINTER MEETING**—Winter meeting of the American Society of Refrigerating Engineers, at the Hotel Statler, New York, N. Y. R. C. Cross, secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **NOVEMBER 27-30, 1955.**

**REFRIGERATION EXPOSITION**—9th Exposition of the Air-Conditioning and Refrigeration Industry, at Atlantic City, N. J., sponsored by the Air-Conditioning and Refrigeration Institute. The name of this trade show, formerly known as the All-Industry Refrigeration and Air Conditioning Exposition, has been officially changed. George Jones, executive secretary of the Institute, 1346 Connecticut Ave., N. W., Washington, D. C. . . . . **NOVEMBER 28—DECEMBER 1, 1955.**

**NUCLEAR CONGRESS**—Nuclear Congress and Atomic Exposition, sponsored by the Engineers Joint Council, to be held in Cleveland, Ohio. Stewart E. Reimel, secretary of the Council, 29 W. 39th St., New York 18, N. Y. **DECEMBER 12-17, 1955.**

# Airsan Viro Crimp

## HIGH VELOCITY AIR FILTERS

**VIRO CRIMP MEDIA**
has special Hemmed Edges for strength and safe, easy handling. No cuts! No Scratches! No Filter surface damage.

AFI MEMBER AIR FILTER INSTITUTE

- MAXIMUM EFFICIENCY (288 — 510 FPM)
- MINIMUM RESISTANCE
- NO DIRECT AIR PASSAGE
- LARGE DUST HOLDING CAPACITY

**Also Available . . .**
**Low Velocity and Grease Filters.**
**Write for catalogs and prices.**

**Air Filter Corporation**
108H NORTH WATER ST. • MILWAUKEE 2, WIS
Canadian Representative
DOUGLAS ENGINEERING CO., LTD., MONTREAL

*A few distributorships available. Write for details!*

---

Now we'll make it, *EZEE!*

**The SHOPMASTER arrived about May 1st.**

- **We find it can be used to perform more operations than anticipated -- in a Fast and Easy way.**

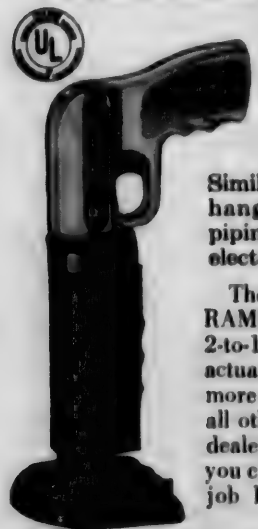
**ENGEL SHEET METAL EQUIPMENT, INC.**
3001 UNION AVE. ST. LOUIS 15, MO.

**Ramset SAVES $11,000**

**for Fastening Air Ducts in Texas' Largest Store**

More than two miles of air conditioning ducts were installed with RAMSET SYSTEM in the new addition to Joske's Department Store at San Antonio, Texas, the "largest store in the largest state."

By using RAMSET Jobmaster, anchoring studs were set at the rate of better than 1 per minute, instead of an estimated 15 minutes each by old-fashioned, conventional methods. Substantial cost savings were thus gained, as well as a far faster, completely secure installation. Similar results were obtained for hanging 13 miles of sprinkler piping and anchoring 43 miles of electric conduit.



The high speed and wide utility of RAMSET SYSTEM have made it the 2-to-1 favorite over all other power-actuated fastening methods—and more contractors use RAMSET than all other makes combined. Ask your dealer or write us for details on how you can make more profit from every job by using RAMSET SYSTEM.

**Ramset Fasteners, INC.**

Ramset Division, Olin Mathieson Chemical Corp.

12135 BEREA ROAD • CLEVELAND 11, OHIO

FIRST IN POWDER ACTUATED FASTENING — AN Olin PRODUCT

(*Continued from page* 156)

The Watts Regulator Co., Lawrence, Mass—now in its 80th year—held a national sales meeting during the week of March 21st at its Lawrence plant. This meeting was attended by 56 agents from all over the United States and Canada. Sessions were held in the Peabody House-Philips Andover Academy. New products for the plumbing and heating trade were introduced. Emphasis was placed on sales engineering.

## OIL USES

**resisted by Euorpeans who fear it may cause unemployment in mines.**

Europe is entering its oil age with a predominantly coal mentality in most of the places where policy is determined according to a N. Y. Times report by M. L. Hoffman.

The way oil is treated, as a fuel by West European governments does not suggest that there is any great interest in encouraging its use. And yet there is wide agreement that a great upsurge in the consumption of energy is ahead for West Europe and that much of the additional energy must come from oil—for the next four or five decades at least.

• **FINANCE.**—Most governments have strong ministries concerned with coal and electric power. They stand up for the interests of these industries, whether nationalized or in private hands.

Except possibly in Italy and Austria the ministry that has the greatest interest in oil is the Ministry of Finance. That department is chiefly interested in how much money it can get out of oil in taxes.

• **PRESSURE.**—There are influential international committees dealing with coal problems such as the Coal Committee of the Economic Commission for Europe and the corresponding committee of the Organization for European Economic Cooperation in Paris. There are "coal economists" in influential spots both on these international bodies and in national governments. There do not seem to be any "oil" economists except those working for the oil companies.

The High Authority of the European Coal and Steel Community in Luxembourg is a powerful advocate for the interests of the coal industry and its hundreds of thousands of employes and dependents.

• **PUBLIC RELATIONS.**—Oil is politically weak in Europe partly because it is widely regarded as "foreign" industry. This is not only or even mainly because of the large element of United States ownership in the big interna-

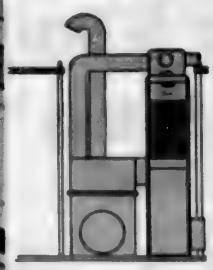
(*Continued on page* 168)

USES NO WATER...COOLS ENTIRE HOUSE!

Uses existing ducts. 5 times cooling capacity of most window units. Also available for roof or ceiling installation. Standard electrical connections. 5-year guarantee.

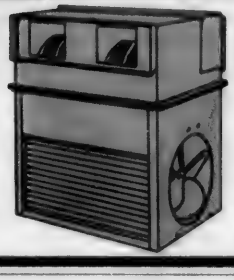
**WRITE** today for complete details.

**GENERAL AIR CONDITIONING CORP.**
Dept. AC, 4542 E. Dunham St., Los Angeles 23, Calif.
NATIONWIDE SALES AND SERVICE



HOW TO COMBINE AIR CONDITIONING AND FORCED AIR HEATING SYSTEMS BY UTILIZING EXISTING HEATING DUCTS

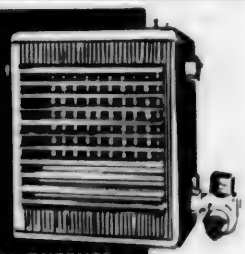
FLOOR MODEL
2 h.p.
Compact unit requires no ducts, does an exceptional cooling job in the average home. Ready for easy installation.



ATTIC, ROOF OR OUTSIDE INSTALLATION UNITS. 2 and 3 h.p. Completely waterproof and insulated against heat of sun. Can also be used for slab floor or basement tie-in.

EXTRA

Delta MAKES THE ONLY OIL-FIRED **UNIT HEATER** WITH OUTPUTS FROM 112,000 TO 280,000 BTU's



Send for FREE 12 page Catalog
DELTA HEATING CORPORATION
TRENTON 8, NEW JERSEY

Representatives in all major cities

# EXHAUST HOODS

The only book published that gives comprehensive information on the flow of air around and into the openings, hoods or slots in exhaust ventilating systems. Covers all phases of hood, booth and slot design. Shows how to determine the required air volume and velocity for hoods and other types of openings for the control of all kinds of dusts, fumes and gases. Sample problems, with the solutions worked out in detail, are given in a chapter devoted entirely to this matter.

141 Pages, 127 Illustrations, 30 Tables, $3.50

**THE INDUSTRIAL PRESS**
93 Worth Street New York 13, N. Y.

Convert Stack Losses into BIG Fuel Savings

with a

**PREFERRED DRAFT-A-JUSTOR**

In that next boiler installation be sure to include a Preferred Barometric Draft-A-Justor. Controls draft automatically and eliminates efficiency losses due to excess air. Thousands of these controls are saving millions of fuel dollars.

- Saves 10 to 30% in Fuel.
- Insures Perfect Draft Control.
- Cuts Losses from Brickwork Leakage.
- Increases $CO_2$ Percentage.
- Reduces Fly Ash Quantity up Stack.
- Cools Walls next to Chimney.
- Ventilates Boiler Room.

*Sizes to meet every job. Approved by Underwriters' Laboratories, Inc. Write for Bulletin 800.*

**PREFERRED UTILITIES MFG. CORP.**
1860 BROADWAY Dept. H NEW YORK 23, N. Y.

# Carrier knows heating

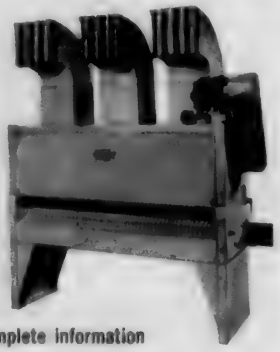
**Over fifty years of leadership in air conditioning have given Carrier unmatched experience in the control of temperature—heating as well as cooling. Yes, Carrier knows heating by experience—and all this engineering skill and leadership contributes to the superiority of Carrier Unit Heaters.**

**CARRIER HEATING AND VENTILATING UNITS**

Compact, versatile units for large-area buildings, schools, auditoriums, gyms, garages, mills and factories of all types. Sectionalized construction adds flexibility to application, ease to installation. Can be horizontally or vertically suspended or floor-mounted. Choice of coil units, discharge patterns, filter sections, manual or automatic damper controls, steam or hot water circulation. Optional sound-deadening and vibration-isolation features. Ratings from 80,000 to 1,260,000 Btu/hr.; 1500 to 31,000 cfm.

**CARRIER INDUSTRIAL HEAT DIFFUSERS**

They distribute heat evenly at full or partial loads. Positive control of heat saves fuel through flow control of steam or hot water, or damper control of air. Sectionalized construction permits floor mounting, vertical or horizontal suspension. Sizes and arrangements for 115,000 to 1,620,000 Btu/hr.



**WRITE** or **USE COUPON** for complete information

Carrier

**air conditioning**
**refrigeration**
**industrial heating**

**CARRIER CORPORATION, 306 S. Geddes St., Syracuse, New York**
Please send folders on features and selection data for Carrier Heating and Ventilating Units and Heat Diffusers.

*Name*_____

*Business*_____

*Address*_____




## OIL USES

(*Continued from page* 166)

tional companies. Royal Dutch Shell is British and Dutch owned. Agip is all Italian.

The construction of large refineries in European port cities has done something to bring the industry closer to Europe in the human sense. But compared to coal, few persons are employed in the refining and distribution of petroleum. The companies have done little or nothing to bring home to Europeans their stake in the industry.

The typical big company advertisement shows pictures of Arabs working around a pipe line or a tanker in a Middle Eastern port. Oil is still an exotic product like pineapples or bananas, to most Europeans.

All these factors are slowing down the use of petroleum-based fuels in West Europe. The petroleum industry believes that this region will need all the coal and all the oil it can get for the next fifty years. But the industry is still doing little to push the use of anything except automobile and diesel fuel.

• **RESTRICTIONS.**—In France the use of oil for home heating actually is restricted by an agreement between the oil companies and the coal distributors' cartel.

The companies have been discouraged from competing more strenuously with coal by price reductions. Only the high level of excise taxes makes gasoline inherently more costly to West Europe than to the United States.

Time and again tentative efforts of the oil companies to give the motorist cheaper gasoline have been met with a prompt increase in taxes equivalent to the price cut.

• **FEAR.** — It seems clear that these various barriers to a rapid increase in the use of oil as an energy source will remain significant until one widely held as fear is laid to rest. This is the fear that, if Europe starts to use more oil in processes hitherto powered mainly by coal, there will be unemployment in the coal mines.

No one, least of all the big oil companies, denies that there is a real sociological problem in the concentration of populations dependent wholly on coal mining in certain parts of Europe. No government can ignore the consequences of this.

The petroleum industry maintains that substitution of oil for coal in terms of processes or uses does not mean substitution in the sense that as more oil is used less coal will be needed. Industry spokesmen maintain that the effect of cheaper fuel on powering an increase in the total activity of industry and thus in the total utilization of energy is bound to keep the demand for coal high indefinitely.

But little has been done to spread this thesis around or to convince politicians, trade union leaders or economists that it is more than just big-company propaganda.

## NATURAL GAS

**put in luxury class by Fulbright in plea to remove Federal controls.**

Consumers of natural gas enjoy a "luxury" fuel and therefore are not entitled to Government control of its price, Senator J. William Fullbright, told a Senate committee in Washington, May 10.

The Arkansas Democrat is the sponsor of a measure to remove the authority of the Federal Power Commission to regulate natural-gas prices at the wellhead.

• **NOT NECESSITY.**—He maintained that consumers always could turn to coal or to oil if they did not like the prices asked for natural gas. He said his bill was aimed at preventing "Yankees from exploiting us."

Senator Fulbright said critics of his bill, who charged that the lack of Federal regulation would add to the burden of gas consumers, "bring up the hypocritical argument" that gas was a necessity. He insisted that a recent Supreme Court decision imposing Federal regulation at the wellhead "will not benefit consumers, but will damage the citizens of gas-producing states."

Senator Fulbright's bill is similar to the measure introduced in the House early this year by Representative Oren Harris, Democrat of Arkansas. It would amend the Natural Gas Act of 1938 to "correct" a Supreme Court decision of last June. This allowed the Federal Power Commission to fix natural-gas prices at the wellhead.

Senator Fulbright replied to questions by Senator John O. Pastore, Democrat of Rhode Island. Senator Pastore acted as chairman of the Senate Interstate and Foreign Commerce Committee in the absence of Senator Warren G. Magnuson, Democrat of Washington.

• **CLASH.** —Regulation is the subject of a clash between natural gas-producing states in the South and Southwest and the consuming areas in the industrial Northeast and Midwest.

Senator Pastore, Senator James H. Duff, Republican of Pennsylvania, and Senator Charles E. Potter, Republican of Michigan, asked today how the ultimate consumer could be protected against unreasonable prices.

Principal concern for the natural gas producer was shown by Senators Lyndon B. Johnson and Price Daniel of Texas and Senator A. S. Mike Monroney of Oklahoma, all Democrats, with Senator Andrew F. Schoeppel, Republican of Kansas.

## ASHAE

**semi-annual meeting to hear technical reports on research and symposium on evaporative cooling.**

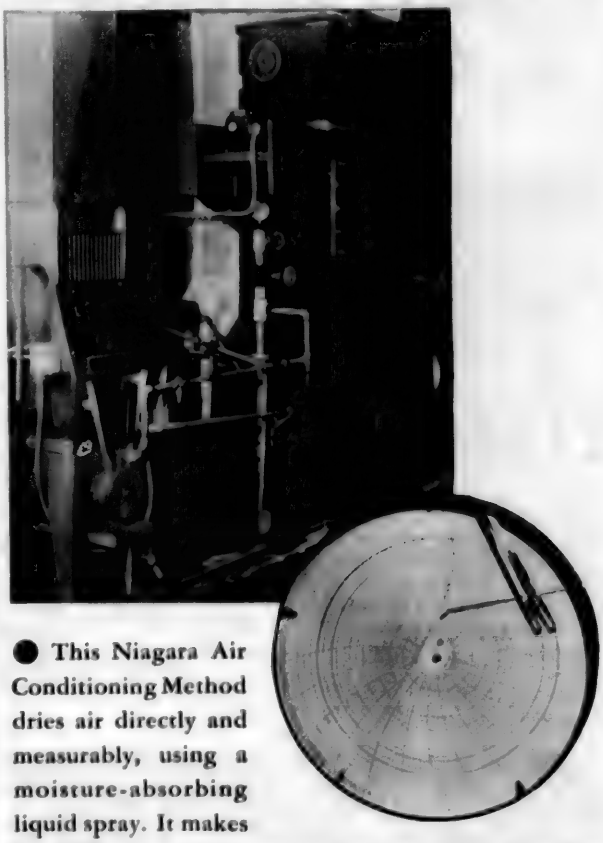
Members and guests attending the Semi-Annual Meeting of the American Society of Heating and Air-Conditioning Engineers will hear technical reports on various research projects, as well as a symposium on evaporative cooling conducted by authorities in this field.

The meeting will be held June 27, 28 and 29 in San Francisco at the St. Francis Hotel with registration beginning on Sunday and thereafter each morning until the concluding day. Meetings of the Council of the Society and various committees will take place prior to and during this three day period. ASHAE president, John E. Haines, and first and second vice presidents, John W. James and Peter B. Gordon, will preside respectively at the opening of each of the sessions.

• **HEAT FLOW.**—Subjects planned for the first session are

(*Continued on page* 170)


# EXACT CONTROL
## of Moisture Content
### To Improve Your Product or Protect Your Materials or for Processes or Tests



● This Niagara Air Conditioning Method dries air directly and measurably, using a moisture-absorbing liquid spray. It makes humidity control a separate function from lowering or raising temperatures and gives you precise control with thermostats alone; no moisture-sensitive devices are needed. You have simpler, more trustworthy, less expensive control instrumentation. Niagara precise-control installations have the best record for reliability.

Niagara Air Conditioning provides you with any temperature and relative humidity you need. Using "Hygrol" absorbent, it is not expensive to operate, saving the refrigeration commonly used to condense moisture and making re-heat unnecessary in most cases. It gives large capacity with compact, easily-maintained equipment. Ask for Descriptive Bulletins #112 and #121. Address Dept. — HV.

**NIAGARA BLOWER COMPANY**

405 Lexington Ave. New York 17, N. Y.

*District Engineers in Principal Cities of U. S. and Canada*

SAVE TIME and MONEY when you form FLEXIBLE CONNECTORS

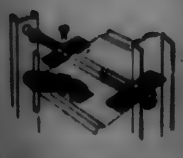
ELGEN SILENT DUCT

*Pats. Pend.

Imagine, this one-piece, factory-assembled metal-to-material unit unrolls absolutely *flat!* No more bothering with unwieldy duct material that buckles easily. Elgen Silent Duct makes on-the-spot work a cinch . . . you just measure and cut. You can fabricate *any type* of flexible duct connector in minutes . . . with half the effort! You can save up to 60%! No more worry about an inventory of "made-up" parts, either. Your choice of U.L. approved, (Gov't. Spec. Mil-D-10860) canvas, Johns-Manville asbestos and U. S. Rubber neoprene coated fibre glass, in 3" or 6" widths attached to 24 or 26 gauge galvanized steel or 24 gauge aluminum to fill every job requirement. All available in handy-to-use 25, 50 or 100 foot rolls.

2 More Elgen Products That Put Profits In Your Pocket!

ELGEN ALL-TITE VANE RUNNER
• Quickest and easiest way ever devised for installing turning vanes for square elbows • No special tools required; vanes lock easily with blow of hammer



ELGEN DAMPERSET
For Multi-Blade Dampers . . . Parallel or Opposed • Most perfect damper hardware developed • Assembles in a jiffy . . . cuts assembly time in half • Easily adjusted and self-aligning. Licensed by Minneapolis-Honeywell

ELGEN PRODUCTS ARE SOLD THROUGH LEADING JOBBERS EVERYWHERE.

"Put Profits In Your Pocket!"

*Write today for free catalog and "spec" sheet!* Dept. D6

ELGEN MANUFACTURING CORP. 41-34 39 Street, Long Island City, N. Y




## ASHAE

(*Continued from page* 169)

the measuring of heat flow through a test house with an analogue computer, winter design temperatures in Canada, and the calculation of heat flow through a flat roof by direct measurement.

• **AIR.**—The amount of air required to keep workers comfortable in commercial laundries, an analysis of the cause of odors in air conditioning coils, and a report on the measurement and breakdown of dust particles sampled from the air in the laboratory, will be the nature of the papers scheduled for the second session.

Arranged for the third session are a report on the presence and causes of gases in hot water heating systems, an explanation of a chart for designing cooling towers, a study of wooden louvers to determine reduction of frictional resistance to air flow, and how the sizing and location of room air outlets can change patterns of air movement.

• **PROGRAM.**—Titles of the papers are as follows:

Electric Analogue Prediction of the Thermal Behavior of an Inhabitable Enclosure, by Harry Buchberg, University of California, Los Angeles

A Method for Determining Winter Design Temperatures, by M. K. Thomas, Deputy Superintendent, Climatology Section, Canadian Government

Periodic Heat Flow Through Flat Roofs, by Merle L. Erickson, Research Assistant, University of Minnesota, and Donald J. Vild, Research Engineer, George V. Parmelee, Senior Research Supervisor and A. N. Cerny, Research Mathematician, ASHAE Research Laboratory

Ventilation of Commercial Laundries by Sidney Marlow, Industrial Hygiene Engineer, New York State Department of Labor

Air Conditioning Coil Odors, by A. B. Hubbard, Liason Engineer, General Electric Company, and Nicholas Deminger and Frederick Sullivan, Senior Research Chemists, Arthur D. Little, Inc.

Size Distribution and Concentration of Airborne Dust, by Kenneth T. Whitby, research Associate, and Professors Axel B. Algren and Richard C. Jordan, University of Minnesota

Sources of Vent Gas in a Hot Water Heating System, by L. N. Montgomery, Research Associate, and Professor Warren S. Harris, University of Illinois

Psychrometric Analysis for Design of Forced Draft Cooling Towers, by Samuel E. Agnon, Mechanical Engineer, Haifa, Israel, and Professor Benjamin H. Spurlock University of Colorado

Resistance of Wooden Louvers to Fluid Flow, by Charles W. Bevier, Research Assistant, Texas Engineering Experiment Station

Performance and Evaluation of Room Air Distribution Systems, by Professors Alfred Koestel and G. L. Tuve, Case Institute of Technology

It is planned that the evaporative cooling symposium will cover the following subjects: Historical, air cooling by evaporation, evaporation from surfaces, weather data limitations, geographical limitations, system design, indirect systems, and water treatment.

• **OKLAHOMA.**—Over 240 members and guests of the American Society of Heating and Air-Conditioning Engineers attending a Regional Meeting in Oklahoma City April 14-16 heard reports by ASHAE president John E. Haines and director of research Elmer R. Kaiser, as well as papers covering residential cooling, removal of moisture, pressure losses of divided-flow fittings, and a new method of calculating air conditioning loads.

## ASRE

### to hold 42nd semi-annual meeting in Milwaukee.

Some of the country's foremost refrigeration and air conditioning engineers will address the 42nd Semi-Annual Meeting of the American Society of Refrigerating Engineers in Milwaukee, Wisconsin, June 12 to 15, at the Hotel Schroeder.

In addition to three technical sessions, the diversified technical program will include an air conditioning conference, a domestic refrigerator engineering conference and six forums.

Program Committee Chairman E. P. Palmatier, Carrier Corp., has announced the following program of technical sessions:

*June 13, Monday A.M.—Technical Session*

The Injection Refrigeration Cycle, by Willis Merle Carter, Professor of Machine Design, University of Kentucky.

Characteristics and Performance of Rotary Compressors, by H. F. Lehmkuhl, Seeger Refrigerator Co.

Moisture Migration in Hermetic Refrigeration Systems as Measured Under Varied Conditions, by W. R. Brisken, Manager Advanced Engineering, G.E. Co.

*June 14, Tuesday A.M.—Technical Session*

Physiological Effects of Environment of Domestic Animals, by H. L. Garver, Agricultural Research Center, Department of Agriculture.

Insulation in Refrigerated Transportation Body Design, by S. W. Eby and R. L. Collister, Armstrong Cork Co.

Moisture Problems in Low Temperature Railroad Transportation, by T. M. Elfving, President, Isoflex Corp.

Rate of Solidification, by D. L. Cochran, Stanford University.

*June 15, Wednesday A.M.—Technical*

New Thermodynamic Properties of Freon-12, by R. C. McHarness, Research Supervisor and Dr. B. J. Eiseman, Jr., Research Chemist, E. I. DuPont de Nemours & Co., Inc., and Prof. J. J. Martin, University of Michigan.

Vibration and Vibration Analysis of Commercial Units, by C. A. Hathaway Chief Engineer and K. A. Merz, Engineer in Charge, Product Development, Torrington Mfg. Co.

Some Practical Aspects of the Dielectric Properties of Refrigerants, by D. A. Beacham and R. T. Divers, Central Engineering Staff, Materials Standards Dept., Carrier Corp.

*June 15, Wednesday P.M.—Air Conditioning Conference*

*NAHB Air Conditioned Village, Austin Report*

Builders View Point of Austin Village, by N. A. Cole, Architect-Builder and President, Fabricon Co., Austin, Texas.

Some of the Interesting Test Results of Austin Village, by C. W. Nessell, Minneapolis-Honeywell.


Super HEAVY DUTY

• SCREENLESS
• RUGGEDLY BUILT
• NON-CLOG IMPELLER

Sewage Ejector

THE ECONOMICAL SEWAGE PUMP with the NON-CLOG impeller!

This WEIL Screenless Heavy Duty Non-Clogging Sewage Ejector is ruggedly built for years of trouble-free operation. WEIL Pumps of this design are still operating satisfactorily after 25 years of service.

This unit is completely factory assembled, economical to install — only one piping connection is required. Pre-assembly and factory testing insure LESS installation time and no "call-back" servicing.

Inherent in the design of this pump is an ample reserve of strength to meet the most severe conditions. The ease and simplicity of installation and the record of many years of trouble-free operation make this pump the logical choice with the engineer, contractor and owner.

Fig. C-9001

This Two Blade NON-CLOG Impeller is the most important part of the screenless non-clog sewage pump. Not only does it effectively handle large diameter solids but it also passes rags and stringy material of various lengths which are washed into the sewage pit. Pumps with this impeller successfully handle difficult pumping jobs such as waste from public toilets, canning plants, hospitals and industrial installations.

Fig. C-9021

This rugged pump casing with wide waterways permits unobstructed passage of the maximum solids handled by a non-clog impeller.

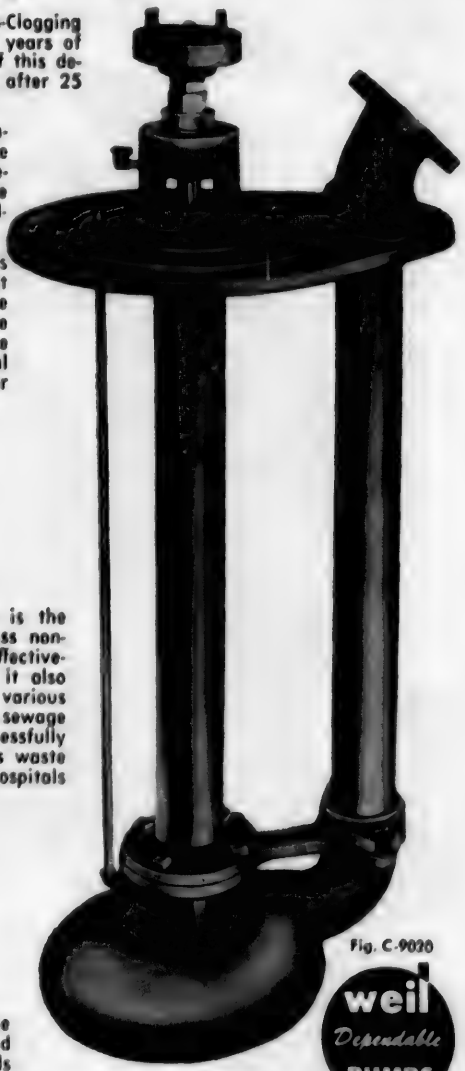


Fig. C-9020

weil Dependable PUMPS

Send for NEW Bulletin C-900 E

weil PUMP CO.

1516 NORTH FREMONT STREET • CHICAGO, ILLINOIS

# NOW--Modine STAINLESS STEEL

## Gas-Fired Duct Furnaces

**POSITIVE RUST PROTECTION** — Here's a new lightweight gas-fired duct furnace with rust- and corrosion-resistant stainless steel heat exchanger and burner. It's specially built for use with cooling coils or packaged air conditioners. Cool, moisture-laden air and condensation which rust ordinary steel tubes and cast iron burners are no hazards to stainless steel. This means greatly extended service life . . . lower maintenance costs . . and wider application possibilities.

**EASIER INSTALLATION** — Modine Duct Furnaces are light in weight, easier and less expensive to handle and install. Only the heat exchanger area, not the entire unit, is enclosed in duct work. Furnaces may be used singly or in multiple.

**CONTROLS ALWAYS ACCESSIBLE** Entire control assembly is mounted on side of unit . . . always readily accessible, even when furnace is near floor or in close quarters where clearance is a problem.

**DIRECT-FIRED HEAT EXCHANGER** — Stainless steel tubes are seam-welded into a rigid, gas-tight heat exchanger. Each tube is individually-fired for most effective and uniform heat transfer.

**TROUBLE-FREE BURNERS** — Stainless steel burners have self-cleaning ports with four times the free area of conventional drilled ports. Sharp edges deter lodging of dirt or scale. Complete burner and manifold assembly are easily removed.

**FIVE SIZES** —88,000 to 213,000 Btu/hr input. Many applications— in air conditioning systems . . . as a concentrated source of heat for central heating systems . . . as "boosters" to supplement a central plant . . . for industrial and agricultural drying, processing and ventilating.

For new Bulletin 855, contact the Modine representative listed in your classified phone book, or write to Modine Mfg. Co. 1511 DeKoven Ave., Racine, Wis.

**Modine** GAS-FIRED STAINLESS STEEL DUCT FURNACES

D-1260




Field Application Suggestions from Austin Village, by D. V. Petrone, President, Typhoon Air Conditioning Co., Inc.

Notes on Equipment Design from Austin Village, by I. P. Sharpe, Manager, Product Planning, Home Heating and Cooling Dept. General Electric Co.

## NUCLEAR HEAT

### from reactor experiment offered for sale by AEC.

The Atomic Energy Commission is inviting proposals by public, cooperative, or private organizations to purchase the heat produced in experimental operation of the sodium graphite reactor now under construction at a site 30 miles northwest of downtown Los Angeles, California, Dr. Willard F. Libby, acting chairman, announced today. As required by the Atomic Energy Act of 1954, the AEC will give preference and priority to public bodies and cooperatives in contracting for the disposal of heat energy produced by the reactor.

• **BUILDERS.**—The reactor, known as the Sodium Reactor Experiment, is one of five reactor systems with which the AEC is currently experimenting in its program for the development of economically competitive nuclear power. The development work and fabrication of the reactor is being done by North American Aviation, Inc., under contract with the AEC. North American is bearing about 25% of the cost of the experiment and will operate the plant when it is completed in 1956.

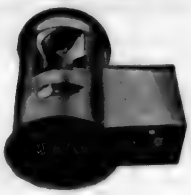
• **OUTPUT.** —The peak heat load of the SRE will be about 20,000 kilowatts, permitting the generation of approximately 7500 kilowatts of electricity. The availability of heat from the reactor will be subject to the demands of the experimental program and therefore no guarantee can be given of the quantity or continuity of energy from the SRE. Despite the unfirm nature of the energy it is believed that valuable operating experience can be gained by generating electric power.

The Atomic Energy Commission has already received a proposal from the Southern California Edison Company to purchase the SRE heat and install, at its own expense, all equipment necessary to convert the heat to electricity.

**STAXAUSTER** can be used to convert all types of roof ventilators into powerful exhaust or air supply units.

# Allen
## EXHAUST FANS

Whether you are working on new construction or motorizing existing ventilators, Allen Exhaust Fans will be the top-performance, quality answer to the particular ventilating problem. Easy to install, economical to operate, these fans meet a wide range of needs. In addition to the Fan Section shown above, the line includes the Remote Drive Allen Staxauster, and for wall installations, the Allen Exhaust Fan and the Lo-Noiz-Level Multiblade Fan. Our representatives are in most principal cities; names listed in our catalog in Sweet's Architectural File, Section 20b.



**Remote Drive Allen Staxauster**
Specially designed for applications handling corrosives and/or high-temperature air.

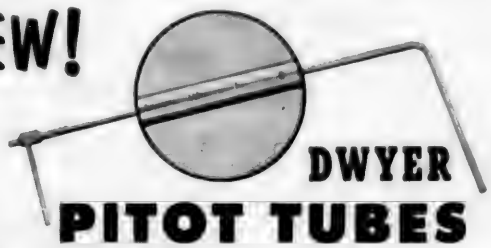
**Write for catalog.**

ALLEN ENGINEERED VENTILATION

**ALLEN COOLER & VENTILATOR INC.**
ROCHESTER, MICH.
*Roof Ventilators for Every Commercial and Industrial Need*

---

# NEW!



# DWYER
# PITOT TUBES

★

*No. 160 Dwyer Pitot Tube shown checking air velocity with No. 1010-1 Magnehelic Gage. Dwyer also makes a full range of inclined and vertical manometers, portable and stationary*

**NOW GRADUATED IN INCHES ON BOTH SIDES**

***Simplify centering in duct, accurate traversing***

Complete range of sizes: 12" to 60" lengths. (Popular set: No. 161—18", No. 163—36".) "P" styles available with integral ⅛" or ¼" pipe thread mounting gland . . . also available with split flange mountings . . . either at slight extra cost.

**● stainless steel throughout ● test-confirmed unity coefficient ● direct reading charts supplied ● meet NAFM, ASH&VE specs ● for temperatures to 800° F. ● clean, burr-free static holes ● priced as low as $12.50**

*Write for Dwyer Bulletin No. B-2*

**F. W. DWYER MFG. CO.** P. O. BOX 373 MICHIGAN CITY, INDIANA

---

# NEW WEINMAN
## type AC centrifugal pump for air conditioning systems

When outside atmospheres are laden with abrasive dust particles, recirculation of cooling water in air conditioning systems using cooling towers becomes a major maintenance headache. Shaft seals become worn far more quickly than normal and leakage occurs.

The Type AC pump was designed specifically by Weinman engineers to render long service under these conditions; in addition to a rotary type mechanical shaft seal, there is provided a reversible ceramic floating seat and carbon washer combination held by a stainless steel spring, insuring longer life and leakproof operation. The shaft is solid stainless steel, preventing rust or corrosion even when cooling water is chemically polluted.

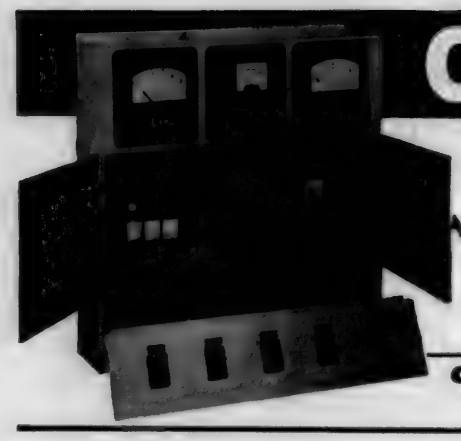
**CLOSE-COUPLED**

**MOUNTS IN ANY POSITION TO FIT REQUIREMENTS**

Wherever thoroughly dependable, trouble-free circulation of hot or chilled water, pressure-boosting, or other general pumping needs are indicated, Weinman Type AC pumps will give superior service. If you have a pump problem, call your nearest WEINMAN Centrifugal Pump Specialist or write for Bulletin 725 . . . perhaps the Type AC pump is exactly what you need!

*Representatives in principal cities.*

*Built by Centrifugal Specialists*



# CFE FACTORY COMPLETED CONTROL PANEL BOARD CABINETS

Complete CFE factory-assembled Panel Board Cabinets save time, cost, worry and service calls on gas, oil, combination fuel or stoker installations. CFE control cabinets group all primary burner controls, flame safe guards, gages, fuses, circuit breakers, etc., in one neat compact standard cabinet 36" square and only 8" deep—available in special sizes to fill your needs.

*Advantages:*

- One responsibility for all controls—including CFE Damper Control and other CFE units as required, specified or furnished.
- All controls mounted, piped and wired into a single unit.
- Convenient terminal connections to simplify external wiring.
- All equipment pre-tested for trouble-free installation and operation.
- Only one purchase order instead of many.
- Greatly reduced "on-the-job" installation time.

*For complete information, write to:*

**Cleveland Fuel Equipment Company**
1111 Brookpark Road, Cleveland 9, Ohio
*In Canada, write to:* Onter Laboratories Inc., 111 Tycos Drive, Toronto

# *Solve Heat Transfer Problems Directly . . . and Accurately!*

INDUSTRIAL HEAT TRANSFER, by F. W. Hutchinson, presents 123 working graphs that permit the direct solution of complex problems of heat transfer. Use of these graphs—which are equal in accuracy to the equations from which they are derived—speeds heat transfer analysis and helps to eliminate errors in calculation. In addition to the complete text, graphs are provided for: air, acetylene, ammonia, benzene, chlorine, ethane, ether, helium, oxygen, pentane, steam, sulphur dioxide, water, and 57 other industrially used liquids and gases.

Get your copy of this valuable working reference book today!

**336 Pages, 136 Charts and Illustrations — $6.00**

**ORDER YOUR COPY FROM**

We pay postage if you send payment in full with your order. Money refunded if you are not satisfied.

# THE INDUSTRIAL PRESS

*Publishers of Air Conditioning, Heating and Ventilating*

***93 Worth Street*** ***New York 13, N. Y.***


# CLASSIFIED ADVERTISING

15 cents a word per insertion. Minimum charge $3.00. No charge for name and address. $10.00 per single-column inch. Payable in advance.

**Manufacturer's Representative**
for leading Eastern manufacturer of nationally advertised line of plug, relief and high pressure service valves, meter connections, pipe tapping machines, etc., to contact any one or all of the following: gas utilities, water works, plumbing, heating and industrial supply houses. Straight commission. Partially established, protected, exclusive territories open. Reply to E. S. Boyer, Director of Sales, Weisbach Corporation, Kitson Valve Division, Philadelphia 29, Pa.

**Manufacturer's Representative**
Seeking new lines? Register your name, territory, line with us. We often get requests from manufacturers seeking representatives. Write Research Director, Air Conditioning, Heating & Ventilating, 93 Worth St., New York 13, N. Y.

**Assistant to Product Sales Manager**
Exceptional opportunity for young graduate engineer interested in sales management. Leading manufacturer of air conditioning, heating, ventilating, and heat transfer equipment has departments for young men seeking position with diversified duties in engineering, sales and business administration. Previous experience with heating and ventilating equipment desirable but not required. Send detailed resume of education, experience and salary required to: Manager of Staff Employment THE TRANE COMPANY, La Crosse, Wisconsin.

1000 SIMULATED ENGRAVED (EMBOSSED) PERSONAL APPOINTMENT OR BUSINESS CARDS—$5.95 postpaid. Blue or black ink—up to seven lines of copy. Mario K. Guglielmi, 1556 K—74th Street, Brooklyn 28, N. Y.

FOR SALE: Foster Wheeler Order CT-1048-0 8-Cell-Redwood Low Head—4000 G.P.M. Cooling Tower. Maverick Mills, East Boston, Mass.

SALES ENGINEER WANTED for responsible position with well known manufacturer of complete line of industrial warm air heating equipment. Experience desired in sales application and layout of oil and gas fired equipment. Engineer's degree preferred, but not essential. Will travel part time to assist established field sales engineers offices. Good opportunities for advancement. State experience and qualifications first letter. Address Box 852, Air Conditioning, Heating and Ventilating, 93 Worth St., New York 13, N. Y.

**Manufacturer's Representative Wanted**
By leading manufacturer to sell to distributors a popular patented fast-welling essential plumbing fixture approved as standard equipment by leading plumbing fixture manufacturers. Supported by national consumer and trade advertising, direct mail and other promotions. Steady repeat business. Leads furnished. Protected territory. Write, stating qualifications, territory actively covered, lines handled, etc. Box No. 853, Air Conditioning, Heating and Ventilating, 93 Worth St., New York 13, N. Y.

# ALPHABETICAL INDEX OF ADVERTISERS


A

Acme Industries, Inc. ..... 32
Adsco Industries, Inc., American District Steam Div. ..... 53
Air Devices, Inc. ..... 26
Air Filter Corp. ..... 165
Airtemp Div. of Chrysler Corp. .. 60
Allen Cooler & Ventilator, Inc. .. 173
Allis-Chalmers Manufacturing Co. .....18-19-143
American Air Filter Co., Inc. ... 79
American Blower Corp. .....66-67
American Brass Co. ..... 63
American District Steam Div., Adsco Industries, Inc. ..... 53
American Machine & Metals, Inc. 1
American Radiator & Standard Sanitary Corp. ..... 64
Ames Iron Works, Inc. ..... 76
Anemostat Corp. of America ... 73
Armstrong Machine Works Inside Front Cover

B

Babcock & Wilcox Co., Boiler Div. 45
Barber-Colman Co. ..... 151
Bell & Gossett Co. ..... 27
Bethlehem Steel Co. ..... 78
Bishop & Babcock Mfg. Co., Massachusetts Blower Div. .... 41
Brunner Manufacturing Co. .... 9
Buffalo Forge Co. ..... 11
Bush Manufacturing Co. ..... 65

C

Carnes Corp. ..... 82
Carrier Corp. ..... 168
Chase Brass & Copper Co. ..... 74
Chrysler Corp., Airtemp Div. ... 60
Clarage Fan Co. .... Inside Back Cover
Classified Advertisements ..... 174
Cleaver-Brooks Co., Boiler Div. .. 145
Cleveland Fuel Equipment Co. ... 174
Connor Engineering Corp. ..... 37
Crane Co. ..... 40
Curtis Refrigerating Machine Div., Curtis Mfg. Co. ..... 28

D

Dehothezat Fans Div., American Machine & Metals, Inc. ..... 1
Delta Heating Corp. ..... 167
Detroit Stoker Co. ..... 51
Domestic Pump & Manufacturing Corp. ..... 81
Dunham, C. A., Co. ..... 38-39
Duriron Co., Inc. ..... 12
Dwyer, F. W., Mfg. Co. ..... 173

E

Elgen Manufacturing Company .. 170
Engel Sheet Metal Equipment, Inc. 165

F

Farr Co. ..... 70
Frick Company ..... 58

G

Gallaher Co. ..... 52
General Air Conditioning Corp. .. 167
General Blower Co. ..... 163
General Electric Co. ..... 46
Gustin-Bacon Manufacturing Co.. 24

H

Halstead & Mitchell ..... 2
Hoffman Specialty Mfg. Corp. .. 25

I

Illinois Testing Laboratories, Inc. 162
Industrial Press ..... 72
Infra Insulation, Inc. ..... 7
Ingersoll-Rand Co. ..... 4

J

Jenkins Bros. ..... 47
Jenn-Air Products Co., Inc. .... 44
Johnson Service Co. .....Back Cover
Joy Manufacturing Co. ..... 50

K

Kramer Trenton Co. ..... 155

L

L-O-F Glass Fibers Co. ..... 56
Liquidepth Indicators, Inc. ..... 164

M

Marley Co. ..... 77
Marlo Coil Co. ..... 30
Marsh Heating Equipment Co. ... 62
Massachusetts Blower Div., Bishop & Babcock Mfg. Co. ..... 41
McDonnell & Miller, Inc. ..... 31
Minneapolis-Honeywell Regulator Co. ..... 34-35
Modine Manufacturing Co. .....54-172
Myers, F. E. & Bro. Co. ..... 17

N

Nash Engineering Co. ..... 84
National Steel Corp., Weirton Steel Co. ..... 29
National Tube Div., United States Steel Corp. ..... 71
Nesbitt, John J., Inc. ..... 20-21
New York Blower Co. ..... 57
Niagara Blower Co. ..... 169
Novelty Steam Boiler Works, Inc. 163

O

Owens-Corning Fiberglas Corp. .. 43

P

Patterson-Kelley Co., Inc. ..... 141
Peerless of America, Inc. ..... 153
Petro ..... 161
Portmar Boiler Co., Inc. ..... 80
Powers Regulator Co. .....13-147
Preferred Utilities Mfg. Corp. ..... 167
Pyle-National Co. ..... 42

R

Ramset Fasteners, Inc. ..... 166
Reading Tube Corp. ..... 55
Revere Copper & Brass, Inc. ..... 137
Reznor Manufacturing Co. ..... 36
Ric-wil, Incorporated ..... 83

S

Sarco Co., Inc. ..... 16
Skidmore Corporation ..... 69
Standard Stamping & Perforating Company ..... 163
Struthers Wells Corp., Titusville Iron Works Co. Div. ..... 59
Sturtevant Div., Westinghouse Electric Corp. ..... 75
Superior Combustion Industries, Inc. ..... 61

T

Titusville Iron Works Co., Div. Struthers Wells Corp. ..... 59
Trane Co. ..... 14-15
Tube-Turns ..... 33

U

Union Asbestos & Rubber Co. .. 49
United States Steel Corp., National Tube Div. ..... 71

W

Want Advertisements ..... 174
Watts Regulator Co. ..... 176
Weil-McLain Co. ..... 68
Weil Pump Co. ..... 171
Weinman Pump Mfg. Co. ..... 173
Weirton Steel Co., National Steel Corp. ..... 29
Westinghouse Electric Corp., Sturtevant Div. ..... 75
Wheeling Corrugating Co. ..... 22-23
Worthington Corp. ..... 149

Y

Youngstown Sheet & Tube Co. ... 48

A SIGN OF . .

# Quality

## FOR OVER 80 YEARS

### Hot Water Heating Safety Valves and Controls

**A.S.M.E. Rated Pressure Safety Valves**

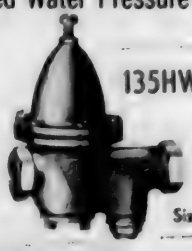
**174**
Series

Sizes ¾" to 2" inclusive

**N74**

Size ¾"

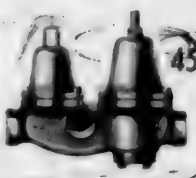
**Feed Water Pressure Regulator**



**135HW**

Sizes ½" to 2"

**Dual Controls**

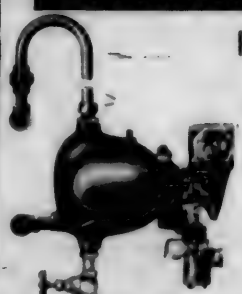


**45A**

Sizes ½"

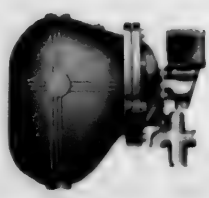
### Steam Heating Boiler Water Level Controls

**Boiler Water Feeders**

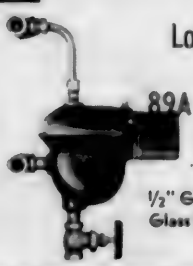


**60LWD** ½" | **76LWD** ¾"

Feeder cut-off combinations
Sq. Ft. Radiation
up to 5,000 | over 5,000



**Low Water Cut-Offs**



**89A**

½" Gauge Glass Type

**93A**

2½" Screw-in Type

### Protective Devices for Hot Water Supply Systems

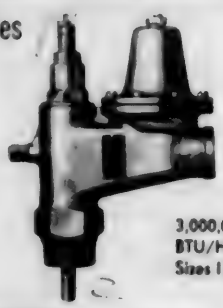
**Fully Automatic Temperature and Pressure Relief Valves**

**N40XL**

500,000 BTU/HR
Size ¾"

**140**

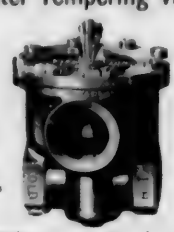
750,000 BTU/HR
Size 1"



**340**

3,000,000 BTU/HR
Sizes 1½" or 2"

**Water Tempering Valve**



**71**

Sizes ½", ¾", 1"

**WATTS Regulator Company**
LAWRENCE, MASSACHUSETTS

THE LARGEST, MOST COMPLETE LINE OF ITS KIND IN THE WORLD

# TABLES FOR DETERMINING RELATIVE HUMIDITY

| Dry Bulb Temp., °F | Wet-Bulb Temperature, °F | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 |
| | Relative Humidity, Per-Cent | | | | | | | | | |
| 87 | 43.0 | 45.8 | 48.7 | 51.6 | 54.6 | 57.7 | 60.8 | 64.0 | 67.3 | 70.6 |
| 88 | 40.8 | 43.6 | 46.4 | 49.2 | 52.1 | 55.1 | 58.1 | 61.2 | 64.4 | 67.6 |
| 89 | 38.8 | 41.4 | 44.1 | 46.9 | 49.7 | 52.6 | 55.5 | 58.5 | 61.6 | 64.7 |
| 90 | 36.8 | 39.4 | 42.0 | 44.7 | 47.4 | 50.2 | 53.0 | 55.9 | 58.9 | 61.9 |
| 91 | 35.0 | 37.4 | 40.0 | 42.6 | 45.2 | 47.9 | 50.7 | 53.5 | 56.4 | 59.3 |
| 92 | 33.2 | 35.6 | 38.1 | 40.6 | 43.1 | 45.8 | 48.4 | 51.2 | 53.9 | 56.8 |
| 93 | 31.5 | 33.8 | 36.2 | 38.6 | 41.1 | 43.7 | 46.2 | 48.5 | 51.6 | 54.4 |
| 94 | 29.8 | 32.1 | 34.4 | 36.8 | 39.2 | 41.7 | 44.2 | 46.7 | 49.4 | 52.0 |
| 95 | 28.3 | 30.5 | 32.7 | 35.0 | 37.4 | 39.8 | 42.2 | 44.7 | 47.2 | 49.8 |
| 96 | 26.8 | 29.0 | 31.1 | 33.4 | 35.6 | 37.9 | 40.3 | 42.7 | 45.2 | 47.7 |
| 97 | 25.4 | 27.5 | 29.6 | 31.7 | 33.9 | 36.2 | 38.5 | 40.8 | 43.2 | 45.7 |
| 98 | 24.1 | 26.1 | 28.1 | 30.2 | 32.3 | 34.5 | 36.7 | 39.0 | 41.3 | 43.7 |
| 99 | 22.7 | 24.7 | 26.7 | 28.7 | 30.8 | 32.9 | 35.1 | 37.3 | 39.5 | 41.8 |
| 100 | 21.5 | 23.4 | 25.3 | 27.3 | 29.3 | 31.4 | 33.5 | 35.6 | 37.8 | 40.0 |
| 101 | 20.3 | 22.2 | 24.1 | 26.0 | 27.9 | 29.9 | 31.9 | 34.0 | 36.1 | 38.3 |
| 102 | 19.2 | 21.0 | 22.8 | 24.7 | 26.6 | 28.5 | 30.5 | 32.5 | 34.5 | 36.6 |
| 103 | 18.1 | 19.9 | 21.6 | 23.4 | 25.3 | 27.1 | 29.1 | 31.0 | 33.0 | 35.1 |
| 104 | 17.1 | 18.8 | 20.5 | 22.3 | 24.0 | 25.9 | 27.7 | 29.6 | 31.6 | 33.6 |
| 105 | 16.1 | 17.8 | 19.4 | 21.1 | 22.9 | 24.6 | 26.4 | 28.3 | 30.2 | 32.1 |
| 106 | 15.2 | 16.8 | 18.4 | 20.1 | 21.7 | 23.5 | 25.2 | 27.0 | 28.8 | 30.7 |
| 107 | 14.3 | 15.8 | 17.4 | 19.0 | 20.6 | 22.3 | 24.0 | 25.8 | 27.5 | 29.4 |
| 108 | 13.5 | 14.9 | 16.5 | 18.0 | 19.6 | 21.2 | 22.9 | 24.6 | 26.3 | 28.1 |
| 109 | 12.6 | 14.1 | 15.6 | 17.1 | 18.6 | 20.2 | 21.8 | 23.5 | 25.1 | 26.8 |
| 110 | 11.9 | 13.3 | 14.7 | 16.2 | 17.7 | 19.2 | 20.8 | 22.4 | 24.0 | 25.7 |

| Dry Bulb Temp., °F | Wet-Bulb Temperature, °F | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 |
| | Relative Humidity, Per-Cent | | | | | | | | | |
| 80 | 100.0 | | | | | | | | | |
| 81 | 95.8 | 100.0 | | | | | | | | |
| 82 | 91.8 | 95.8 | 100.0 | | | | | | | |
| 83 | 87.9 | 91.8 | 95.9 | 100.0 | | | | | | |
| 84 | 84.2 | 88.0 | 91.9 | 95.9 | 100.0 | | | | | |
| 85 | 80.7 | 84.4 | 88.2 | 92.1 | 96.0 | 100.0 | | | | |
| 86 | 77.3 | 80.9 | 84.6 | 88.3 | 92.1 | 96.0 | 100.0 | | | |
| 87 | 74.0 | 77.5 | 81.1 | 84.7 | 88.4 | 92.2 | 96.0 | 100.0 | | |
| 88 | 70.9 | 74.3 | 77.7 | 81.2 | 84.8 | 88.5 | 92.2 | 96.1 | 100.0 | |
| 89 | 67.9 | 71.2 | 74.5 | 77.9 | 81.4 | 84.9 | 88.5 | 92.3 | 96.1 | 100.0 |
| 90 | 65.0 | 68.2 | 71.4 | 74.8 | 78.1 | 81.5 | 85.0 | 88.7 | 92.4 | 96.2 |
| 91 | 62.3 | 65.4 | 68.5 | 71.7 | 75.0 | 78.3 | 81.7 | 85.2 | 88.8 | 92.5 |
| 92 | 59.7 | 62.7 | 65.7 | 68.8 | 72.0 | 75.2 | 78.5 | 81.9 | 85.4 | 89.0 |
| 93 | 57.2 | 60.1 | 63.0 | 66.0 | 69.1 | 72.2 | 75.4 | 78.7 | 82.1 | 85.5 |
| 94 | 54.8 | 57.6 | 60.4 | 63.4 | 66.3 | 69.4 | 72.5 | 75.7 | 78.9 | 82.3 |
| 95 | 52.5 | 55.2 | 58.0 | 60.8 | 63.7 | 66.6 | 69.6 | 72.7 | 75.9 | 79.2 |
| 96 | 50.3 | 52.9 | 55.6 | 58.4 | 61.2 | 64.0 | 66.9 | 70.0 | 73.0 | 76.2 |
| 97 | 48.2 | 50.7 | 53.3 | 56.0 | 58.7 | 61.5 | 64.3 | 67.2 | 70.2 | 73.3 |
| 98 | 46.1 | 48.6 | 51.1 | 53.7 | 56.4 | 59.0 | 61.8 | 64.6 | 67.5 | 70.5 |
| 99 | 44.2 | 46.6 | 49.0 | 51.5 | 54.1 | 56.7 | 59.4 | 62.1 | 64.9 | 67.8 |
| 100 | 42.3 | 44.7 | 47.0 | 49.5 | 52.0 | 54.5 | 57.1 | 59.7 | 62.5 | 65.3 |
| 101 | 40.5 | 42.8 | 45.1 | 47.4 | 49.9 | 52.3 | 54.8 | 57.4 | 60.1 | 62.8 |
| 102 | 38.8 | 41.0 | 43.2 | 45.5 | 47.9 | 50.2 | 52.7 | 55.2 | 57.8 | 60.4 |

| Dry Bulb Temp., °F | Wet-Bulb Temperature, °F | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 |
| | Relative Humidity, Per-Cent | | | | | | | | | |
| 103 | 37.2 | 39.3 | 41.5 | 43.7 | 46.0 | 48.3 | 50.6 | 53.1 | 55.6 | 58.1 |
| 104 | 35.6 | 37.7 | 39.8 | 41.9 | 44.1 | 46.4 | 48.7 | 51.1 | 53.5 | 56.0 |
| 105 | 34.1 | 36.1 | 38.1 | 40.2 | 42.4 | 44.6 | 46.8 | 49.1 | 51.5 | 53.9 |
| 106 | 32.6 | 34.6 | 36.6 | 38.6 | 40.7 | 42.8 | 45.0 | 47.2 | 49.5 | 51.8 |
| 107 | 31.2 | 33.1 | 35.1 | 37.0 | 39.1 | 41.1 | 43.2 | 45.4 | 47.6 | 49.9 |
| 108 | 29.9 | 31.7 | 33.6 | 35.5 | 37.5 | 39.5 | 41.5 | 43.6 | 45.8 | 48.0 |
| 109 | 28.6 | 30.4 | 32.2 | 34.1 | 36.0 | 37.9 | 39.9 | 42.0 | 44.1 | 46.2 |
| 110 | 27.4 | 29.1 | 30.9 | 32.7 | 34.6 | 36.4 | 38.4 | 40.4 | 42.4 | 44.5 |

| Dry Bulb Temp., °F | Wet-Bulb Temperature, °F | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 |
| | Relative Humidity, Per-Cent | | | | | | | | | |
| 90 | 100.0 | | | | | | | | | |
| 91 | 96.2 | 100.0 | | | | | | | | |
| 92 | 92.6 | 96.3 | 100.0 | | | | | | | |
| 93 | 89.1 | 92.6 | 96.2 | 100.0 | | | | | | |
| 94 | 85.7 | 89.1 | 92.7 | 96.3 | 100.0 | | | | | |
| 95 | 82.5 | 85.8 | 89.2 | 92.8 | 96.4 | 100.0 | | | | |
| 96 | 79.4 | 82.6 | 85.9 | 89.4 | 92.8 | 96.4 | 100.0 | | | |
| 97 | 76.4 | 79.5 | 82.8 | 86.1 | 89.5 | 92.9 | 96.4 | 100.0 | | |
| 98 | 73.5 | 76.6 | 79.7 | 82.9 | 86.2 | 89.5 | 92.9 | 96.4 | 100.0 | |
| 99 | 70.7 | 73.7 | 76.7 | 79.9 | 83.0 | 86.3 | 89.6 | 93.0 | 96.5 | 100.0 |
| 100 | 68.1 | 71.0 | 73.9 | 77.0 | 80.0 | 83.2 | 86.4 | 89.7 | 93.1 | 96.5 |
| 101 | 65.5 | 68.3 | 71.2 | 74.1 | 77.1 | 80.2 | 83.3 | 86.5 | 89.8 | 93.1 |
| 102 | 63.1 | 65.8 | 68.6 | 71.4 | 74.3 | 77.3 | 80.3 | 83.4 | 86.6 | 89.8 |
| 103 | 60.7 | 63.4 | 66.0 | 68.8 | 71.6 | 74.5 | 77.4 | 80.4 | 83.6 | 86.7 |
| 104 | 58.5 | 61.0 | 63.6 | 66.3 | 69.1 | 71.9 | 74.7 | 77.6 | 80.7 | 83.7 |
| 105 | 56.3 | 58.8 | 61.3 | 63.9 | 66.6 | 69.3 | 72.1 | 74.9 | 77.8 | 80.8 |
| 106 | 54.2 | 56.6 | 59.1 | 61.6 | 64.2 | 66.9 | 69.5 | 72.3 | 75.1 | 78.0 |
| 107 | 52.2 | 54.5 | 56.9 | 59.4 | 61.9 | 64.5 | 67.1 | 69.7 | 72.5 | 75.3 |
| 108 | 50.2 | 52.5 | 54.8 | 57.2 | 59.7 | 62.2 | 64.7 | 67.3 | 70.0 | 72.7 |
| 109 | 48.4 | 50.6 | 52.9 | 55.2 | 57.5 | 60.0 | 62.4 | 64.9 | 67.6 | 70.2 |
| 110 | 46.6 | 48.7 | 50.9 | 53.2 | 55.5 | 57.9 | 60.2 | 62.7 | 65.2 | 67.8 |

| Dry Bulb Temp., °F | Wet-Bulb Temperature, °F | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 100 | 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 |
| | Relative Humidity, Per-Cent | | | | | | | | | |
| 100 | 100.0 | | | | | | | | | |
| 101 | 96.5 | 100.0 | | | | | | | | |
| 102 | 93.1 | 96.5 | 100.0 | | | | | | | |
| 103 | 89.9 | 93.2 | 96.6 | 100.0 | | | | | | |
| 104 | 86.8 | 90.0 | 93.3 | 96.6 | 100.0 | | | | | |
| 105 | 83.8 | 86.9 | 90.1 | 93.4 | 96.6 | 100.0 | | | | |
| 106 | 80.9 | 84.0 | 87.1 | 90.2 | 93.4 | 96.7 | 100.0 | | | |
| 107 | 78.2 | 81.1 | 84.1 | 87.1 | 90.2 | 93.4 | 96.7 | 100.0 | | |
| 108 | 75.5 | 78.3 | 81.2 | 84.2 | 87.2 | 90.3 | 93.4 | 96.7 | 100.0 | |
| 109 | 72.9 | 75.7 | 78.5 | 81.3 | 84.3 | 87.3 | 90.4 | 93.5 | 96.7 | 100.0 |
| 110 | 70.4 | 73.1 | 75.8 | 78.6 | 81.5 | 84.4 | 87.4 | 90.4 | 93.6 | 96.8 |

# "PACKAGED" FANS

## Clarage V-belt Ready Units answer economically your smaller air handling requirements

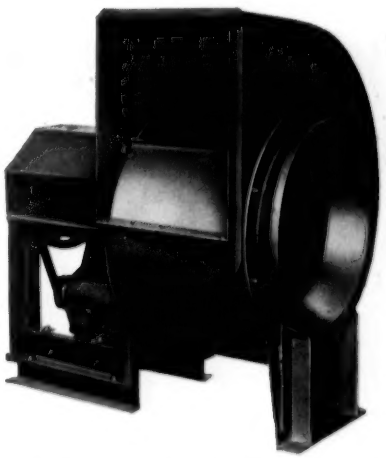
**complete** Ready to run, with fan, motor, and drive in one compact, easily installed assembly. 18 sizes, wheel diameters 9¾ to 32½", capacities to 12,000 cfm. Direct connected units also available.

**adaptable** Quickly adjustable in the field for various directions of air discharge. Slow speed, forward curved blade wheels or medium speed, backwardly inclined blade wheels available. Special units for handling corrosive gases and other special assignments can be provided.

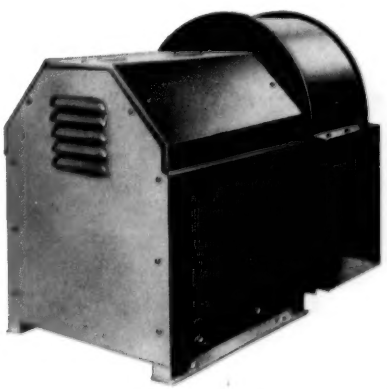
**rugged** Typical Clarage heavy-duty construction throughout. All working parts readily accessible, yet entire drive (except on largest sizes) is within frame of unit — an important distinguishing feature!

**quiet** When properly selected and applied, Clarage Ready Units meet the most exacting requirements in respect to quietness of operation.

**capable** Within their performance range, these units are unsurpassed for maximum air delivery at low power cost. You can select them with confidence for ventilation, exhausting, and other low pressure applications.



View of a standard Ready Unit as built in the medium-size range. Note how operating parts are shielded.



Ready Unit equipped with drive guard (at the end) and outdoor covers (on the sides) which provide complete weather protection.

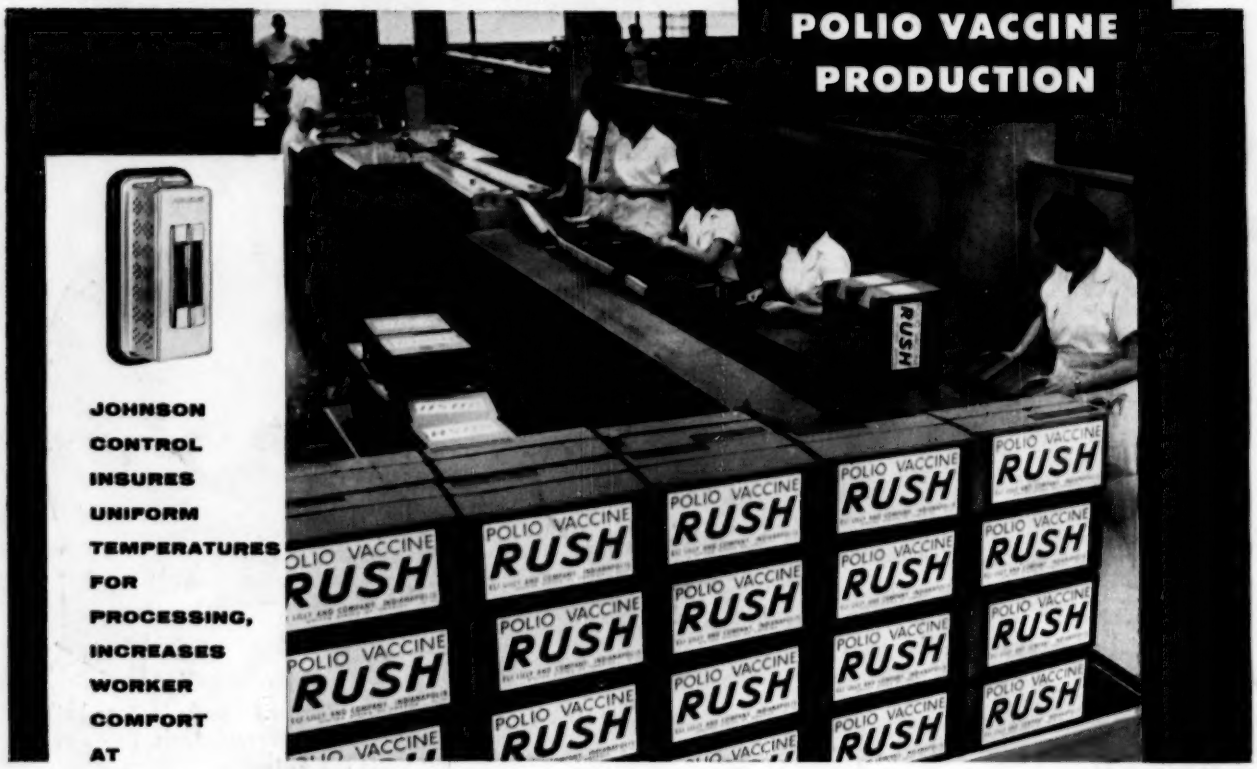
For 28 pages of complete information on Clarage Ready Units, request Catalog 515.

**CLARAGE FAN CO., Kalamazoo, Mich.**

You can Rely on **CLARAGE** ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

# MADE-TO-ORDER-TEMPERATURES PLAY KEY ROLE IN POLIO VACCINE PRODUCTION




**JOHNSON CONTROL INSURES UNIFORM TEMPERATURES FOR PROCESSING, INCREASES WORKER COMFORT AT ELI LILLY AND COMPANY**

A dramatic race against time highlighted the mass production program for Salk anti-polio vaccine. At Eli Lilly and Company in Indianapolis—a major producer of the vaccine—medical scientists, production experts and engineering specialists worked with remarkable speed to perfect processing techniques and provide the necessary production facilities.

A variety of heating, cooling, ventilating and humidity control problems were involved. Controlled spaces include incubation and test rooms, sterile processing areas, filling, labeling and packaging rooms, animal quarters and animal test rooms.

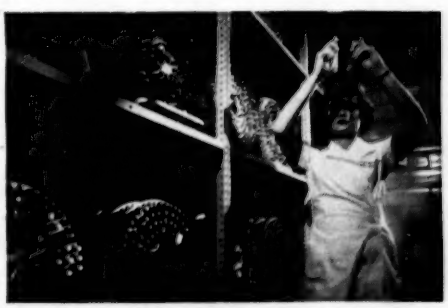
As the special requirements of each of these areas were determined and the engineering work planned, Johnson engineers concurrently planned the control systems and readied them for installation. In some areas, the flexibility of existing Johnson Control installations made it possible to satisfy the new needs with only a few simple rearrangements or adjustments.

The critical nature of polio vaccine production puts a premium on both accuracy and dependability of control. On the basis of past experience with Johnson Control, extending over a period of more than 40 years, Eli Lilly and Company entrusted many of these important control installations to Johnson. All work was completed within the alloted time limits, and the apparatus is functioning at the desired efficiencies.

Johnson Control combines the adaptability, accuracy and economy to solve correctly any problem of heating, cooling, ventilating, air conditioning or process control. Whether your problem involves comfort control or the provision of protective temperatures and humidities for products and processes, talk it over with a nearby Johnson engineer. His advice is yours without obligation. JOHNSON SERVICE COMPANY, Milwaukee 2, Wisconsin. Direct Branch Offices in Principal Cities.

Three types of live polio virus are grown in this incubation room. Johnson Thermostats, regulating Johnson Valves on steam and chilled water coils of the fan unit, maintain a uniform temperature of 96°F. Accuracy is within ± ½°F. under normal operating conditions.

In another incubation room, which is also maintained at 96°F., test tubes revolve on drums in safety and potency tests. In labeling and packaging rooms (shown at top of page), workers enjoy ideal temperature and humidity conditions for comfort.



**JOHNSON CONTROL**

TEMPERATURE ↕ AIR CONDITIONING

**PLANNING • MANUFACTURING • INSTALLING • SINCE 1885**